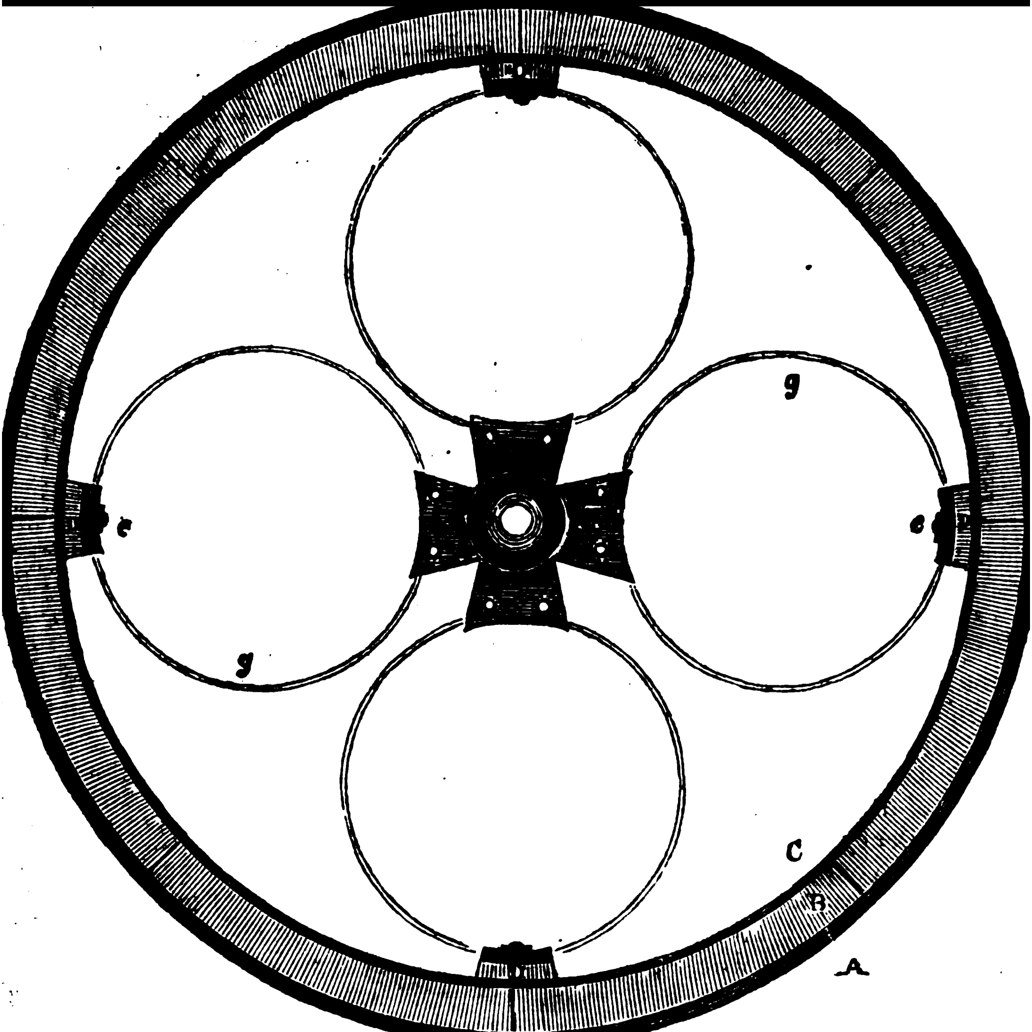

Iron

Charles Vignoles
Civil Engineer

Engraved by R. Roffe, from an Original Miniature.

For the Mechanics Magazine Vol. XXIII.

Published Oct.r 1st 1835 by J. Cunningham Peterboro' Court.

THE

MECHANICS' MAGAZINE,

MUSEUM,

Register, Journal,

AND

GAZETTE,

APRIL 4—SEPT. 25, 1835.

VOL. XXIII.

" Books are not absolutely dead things, but do contain a potency of life in them to be as active as that soul whose progeny they are; nay, they do preserve, as in a vial, the purest efficacy and extraction of that living intellect that bred them. I know they are as lively and as vigorously productive as those fabulous dragon's teeth; and being sown up and down, may chance to spring up ARMED MEN."—MILTON.

LONDON:

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NO. 6, PETERBOROUGH COURT.

1835.

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Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 608. SATURDAY, APRIL 4, 1835. Price 3d.

CUNNINGHAM'S TRAVELLING LIFE-APPARATUS.

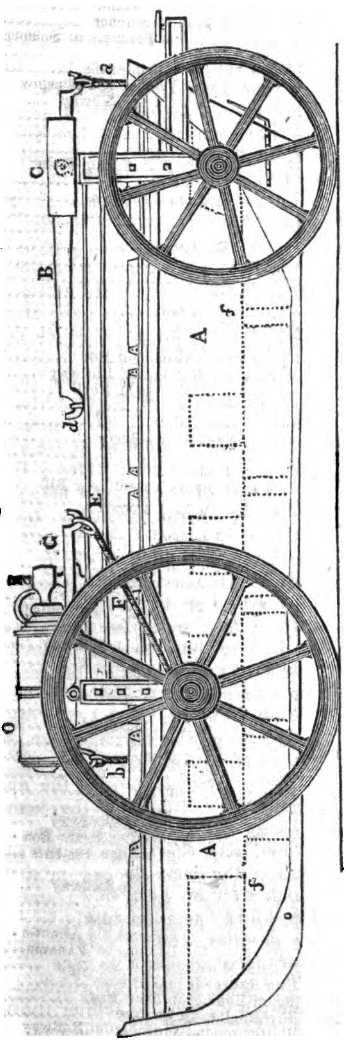


Fig. 1.

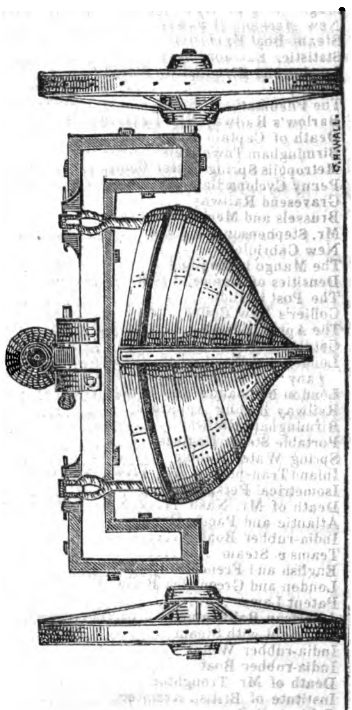


Fig. 2.

TRAVELLING LIFE-APPARATUS.

Sir,—The accompanying drawings represent a travelling life-apparatus, the intention of which is, to combine in one expeditious travelling-carriage every means which can contribute toward the salvation of the lives of shipwrecked mariners.

It consists of a life-boat gun for heaving lines—a catamaran for clearing surfs—and a carriage for the conveyance thereof; which last can be used for the transportation of anchors and cables, scaling-ladders for cliffs, and in war for defence of the coast. It might also be used for the purpose of accompanying armies, and enabling them to cross rivers; uniting, in one machine, the baggage-waggon, pontoon, and gun-carriage.

The models (of which the accompanying are correct drawings) have been already laid before several of the public boards; and I have been endeavouring for these two years to get it adopted, but without success.

An invention on such a subject should not be kept a secret, particularly at this stormy season of the year, when the dangers of our coast are so much aggravated, and call so loudly for every means which can be used to ameliorate the horrors of shipwreck. Will you, then, assist me in giving it additional publicity, by recording it in the pages of your valuable Periodical?

I am, Sir, yours obliged,

Henry Duncan Cunningham.

Gosport, March 28, 1836.

P. S.—I shall be much pleased to see my machine noticed by some of your French subscribers. I am informed, they are at present forming stations along their northern coasts.

Description of the Engravings.

Fig. 1 is the life-carriage with its appendages, ready for travelling. The interior construction of the boat A A may be understood by the dotted sectional view: *f f* is a platform parallel with the line of floatation, which is taken when the boat is fully manned and equipped. From this platform are tubes which communicate with the water, through the bottom. There are two of these tubes between each thwart, one upon each side, and close to the keel, and by them any water the boat ships runs out again. But to enable the boat to free herself as soon as possible, increased buoyancy is given by all the parts not occupied by the rowers and setters, being fitted in with a casing of wood, flush with the thwarts, and covered with fine painted or oiled duck. The boat is on the dimensions of a 10-oared cutter. A hollow copper, or tin gun-wale streak, is carried round the outside, capable of holding several gallons of air. By these precautions, the danger of swamping is entirely removed, and the difficulty of capsizing so great, as to permit the boat to right when the keel is nearly parallel with the surface of the water. The midship tubes are advantageously employed for the purpose of weighing or carrying anchors, the fall being led through them to a windlass also placed amidships.

On the hindmost axletree of the carriage are two levers, of which G is one. The head of the bolt, or linch-pin, is so constructed as to form the fulcrum to another large lever B, equal to the two smaller ones G G. The linch-pin is represented by the dotted figure at C. The parallelogram which hides it from view is the end of one of the magazines for supplying ammunition to the carronade O, intended to heave lines to ships in distress. By means of the levers the boat is attached to the carriage, and they are so proportioned as to allow one man at each small lever, and two men at the large one, to heave the boat up. The ends are secured by the rope F, and the ring-bolt *d*; *b* and *a* are slings attached to the boat. A better idea of the formation of the carriage, &c. may be conceived by fig. 2.

The process of working the apparatus is this:—In attaching the boat to the carriage the latter is wheeled over the former, and the slings in the sides and stern of the boat hooked to the levers, which are then hove down and secured. The whole operation might be done in a few minutes, and in a reversed manner with the same speed.

The gun is used by withdrawing the linch-pin C, thus detaching the shaft E from the fore-axletree, the end of which being allowed to go upon the ground prevents recoil. A line is then fired, and

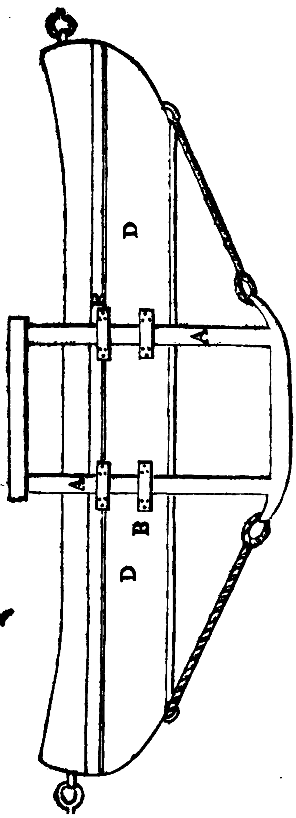


Fig. 3.

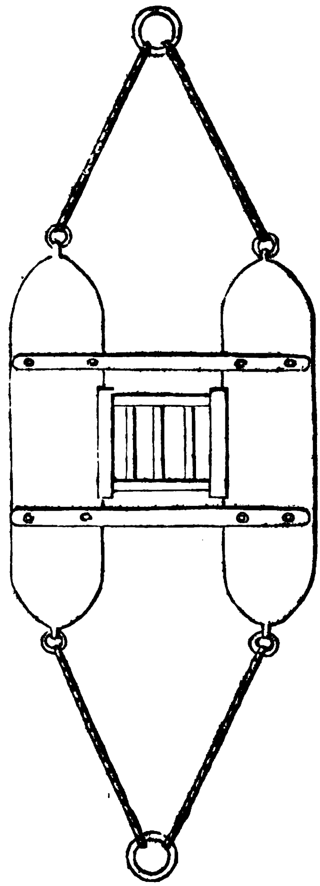


Fig. 4.

a communication established between the ship and the shore—if the distance is great, by means of the life-boat, but if through much surf by the catamaran, which would in that case be the safest mode.

There are many parts of the coasts of England which consist of long flat bays, in every part of which ships are liable to go on shore, or be in distress; for instance, White-Sand Bay, near Plymouth, which extends for ten or twelve miles. Now, a life-apparatus cannot be stationed at every part of this distance; consequently, the only way which such a place can be supplied effectively, is to have a machine which can be transported to any part, and any distance, with facility and speed.

Suppose a life-machine, on this plan, were stationed at Looe, and a vessel is observed to be in distress in the middle of the bay. The carriage would be dispatched with all expedition, and in a short time arrive at the spot. But, in the interim, the ship has gone on shore, and in such a situation that the only way of communicating is by means of a rope. In a few minutes the boat is detached from the carriage, the gun brought in operation, and a line having been fired, the people are taken out, by means of the catamaran, before the vessel goes to pieces. Many other examples

might be adduced, which will appear evident to those who are acquainted with the dangers of a sea-coast.

Finally, for war and defence of the coast, this apparatus would be eminently useful. Suppose each intermediate coast-guard station were furnished with a life-carriage, and that an attack from boats were anticipated at any point, by means of signals, a brigade of guns, served by the station men, might in a short time be formed, sufficiently strong to repulse even a very serious attack. Again, in the event of an army campaigning in a country intersected by rivers; and of their requiring not only artillery, but means to pass the aforesaid rivers, a brigade of these machines, with flat-bottomed boats, would answer the purposes of both. By heaving lines across, a floating bridge might in a short time be constructed, thus superseding the use of pontoons. The guns of the carriages might, if required, be employed to cover the landing.

The Catamaran.

The catamaran consists of two copper boats, strongly joined together, as in fig. 4. Between them is an iron cradle (see fig. 3). D D is the interior view of one of the boats; A A is one of the frames of the cradle, furnished at the bottom with a flat iron sledge, and sliding freely in the slides B B. The bottom of the cradle is grated, and upon this the man stands: his weight being thus considerably below the line of floatatation, or the centre of gravity, and the two boats acting in opposition to each other, the possibility of upsetting is almost entirely removed.

As the catamaran is represented in fig. 3, it is afloat; but when it takes the ground the cradle slides up, and the bottom coming on a level with the bottom of the boats, its passage over sand or shingle, when being beached, is very easily effected.

After the line from the gun has taken effect, the catamaran is hauled off by those on board, another rope attached to it being held by those on shore.

The catamaran will hold two or three persons, and is placed or carried in the life-boat when the machine is travelling. If used at night, a light may be attached to it, as in the life-buoy.

H. D. C.

LUMINOUS APPEARANCE OF THE SEA.

Sir,—In your fifteenth volume, Colonel Macerone and Mr. Von Egmont gave some account of the luminous appearance of the sea, as observed by them; and since every piece of information concerning natural phenomena may be serviceable to those who desire to investigate truth, you will perhaps consider the following as worthy a place in your Journal:—

From Tanoor, on the Malabar coast, to Trivanderam, a distance of above 200 miles, there is a fine back-water, running parallel to and at a distance of from an hundred yards to three miles from the sea, which while in some places it has the appearance of a narrow rivulet, at others opens out into noble lakes several miles in extent. This back-water receives the contents of the numerous streams and rivers, which descend from the range of ghauts in the interior, and during the monsoon has communications with the sea every two or three miles, the greater number of which are, however, blocked up with sand during the dry months; the whole of the neck of land which separates the inland waters from the ocean being but a bank of sand, evidently thrown up during a long course of years by the opposing action of the violent and numerous mountain torrents coming in contact with (at that season) the equally raging sea. Having said thus much in explanation, I shall merely extract the remainder from my journal:—

"Jan. 26, 1833.—In passing between Cranganore and Cochin, the water, wherever struck by the oars, or a fish happened to glide along, presented a more luminous appearance than I have ever before witnessed. In our passage, repeatedly, but for a few yards only at a time, a kind of unctuous oily substance, of the greatest brilliancy, appeared to be stirred up by the oars, and floated on the surface of the water, continuing to shed its light for the space of at least half a minute, so that the succession of circles of this substance, caused by the dip of the oars in the wake of the boat, had the most brilliant appearance. On the hand being dipped into it, it became immediately lighted up as if rubbed over with phosphorus, and had the property of giving a luminous appearance for a few seconds to clothes, wood, or whatever else it

came in contact with. The tracks of the fish, darting from the head of the boat as it approached them, could easily be traced by the brilliant appearance of the water which they put in motion.

"Feb. 3.—In coming down the back-water I saw the same appearance as before mentioned; but the water appeared like liquid sheets of blue and green fire, from the reflection of the moon which was nearly at the full; no one who has not seen it can imagine the brilliant appearance it exhibited."

Yours obediently,

BERGEIN.

Surat, October 1, 1834.

THE LONDON AND BIRMINGHAM RAILWAY.

A correspondent at Tring writes to us as follows:—"The excavation, for the London and Birmingham Railway, through Tring-hill, is proceeding rapidly. Mr. Townsend, the contractor, has upwards of 500 men employed, besides a great number of horses. It is expected they will intercept the '*Bulbourne springs*' when they get deeper. These springs at present come directly into the Grand Junction Canal. There is only one fault to be found with the work in this neighbourhood, and that is *the steepness of the banks*, they being only, for the excavations, in the ratio of nine inches horizontal to one foot perpendicular. In the event of a sharp frost, this ground, which is a sort of chalk-rag, will slake down like lime, and will consequently be a great nuisance, after the road is finished. The banks of the Grand Junction Canal, in the deep cuttings collateral with the railroad, are more than one to one, yet the slips which have occurred after a sharp frost have been prodigious."

The observations of our correspondent on the disproportionate character of the cuttings, seem well deserving the attention of the Directors and their Engineer.

Some months ago, the Directors offered, by public advertisement, a premium of One Hundred Guineas for—1st, The strongest and most economical form of rail; 2d, The best construction of chair or pedestal; and 3d, The best mode of connecting the rail and chair, and also the latter to the stone-block or wooden sleeper; it being provided that no railway-bar should weigh less than 50lbs. per single lineal yard. A great many plans were, in pursuance of this advertisement, sent into the Directors; and the whole were referred by them to the examination of three very competent judges, Mr. Barlow, Mr. Wood, and Mr. Rastrick, with a request that they would report which of the several plans appeared entitled to the premium. The report of these gentlemen was to this effect,—that no one of the patterns or plans fulfilled the conditions required by the advertisement, but that "the form of rail shown in model No. 8, with its chair, and the mode of fixing the rail to the chair (according to the chair pattern No. 3, and model No. 8), is that which the Committee consider the best, as respects the two first conditions of the advertisement; and that the method of fixing the chair to the stone-block, shown in model No. 5, is that which they consider best, as respects the third condition of the advertisement." The Directors have, therefore, come unanimously to the resolution, "that they would not be justified in giving the premium for any one individual pattern or plan, but that the sum of 70*l.* should be presented to the inventor of model No. 8, and the sum of 35*l.* to the inventor of No. 5."

We beg to invite the inventors of the models No. 8 and No. 5, to favour us with descriptions of their respective inventions, for insertion in our publication. It would be satisfactory to the other competitors to be made acquainted with those modes of construction which have been preferred to theirs; and the publication of them might very possibly be the means of bringing forward a better plan than any that has yet been offered.

CHILDREN CHIMNEY-SWEEPERS.

Sir,—I am desirous to caution the public against an expedient which is now diligently practising by the master chimney-sweepers who employ climbing children, to deter housekeepers from generally employing machinery. They lend themselves without any seeming reluctance, to an order for the machine;

but then they make use of Smart's. Glass's has been described in the Mech. Mag. (No. 582), and is perfectly suited to its purpose, and does no injury to the chimney. But the machine they use consists of a number of iron tubes, which do not fit into each other, and are merely strung upon a cord. When thrust up, this string of tubes forms itself into angles against the sides of the chimney, and the edges of the tubes seriously injure the pargetting and brick-work. Besides this, though I have seen a great many of these machines about of late, I have not seen one the brush of which was at all capable of cleansing.

Once more, then, I do entreat your readers to employ no chimney-sweeper who keeps a climbing boy; and not to suffer any other than Glass's machine to be used in their houses—at least until some better instrument shall be made public.

I am, Sir,

Your obedient servant,

ARCHIBALD ROSSER.

15, New Boswell-court, Lincoln's-inn,
March 26, 1835.

SINGULAR HYDRAULIC PHENOMENON.

Fig. 1.

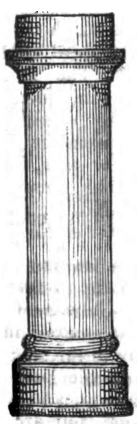


Fig. 2.

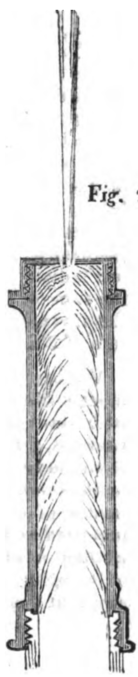
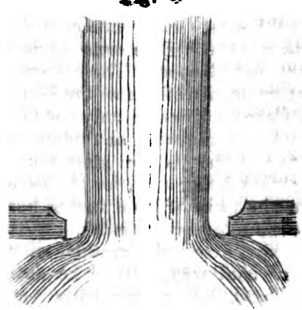


Fig. 3.



G.H.W.

"The motion of fluids, and the friction and other causes by which it is impeded, forms one of the most elaborate and abstruse branches of mathematical philosophy." *Professor Millington.*

Sir,—While some comparative trials were being made between some engines belonging to the London Fire Establishment, opportunity was taken of ascertaining the effect of a short cylindrical branch-pipe, which is represented in the accompanying drawing, fig. 1. It consisted of a straight metal cylinder, twelve inches long, closed at the top by a flat brass cap, having a circular opening in its centre, seven-eighths of an inch in diameter. Previous to the employment

of this kind of branch-pipe, I had foretold an unfavourable result, from the interference of opposing currents, but must confess I was by no means prepared for what followed, which was of so extraordinary a nature as to surprise all the persons who witnessed the phenomenon.

When the engine first began working, a jet of water seven-eighths of an inch in diameter issued from the aperture in the cap of the branch-pipe, but as soon as the men got into full work, *the stream of water diminished in size*, and appeared to correspond very nearly with that delivered by a five-eighths nose-pipe.

On a close and careful examination, it was found *that the jet of water did not much exceed five eighths of an inch in diameter*, and that it issued *without touching any part of the aperture in the cap!*

This effect is represented as taking place in the section, fig. 2, which, as well as fig. 1, is drawn on a scale of two inches to a foot. Fig. 3 is a section of the aperture in the cap of the branch-pipe, with the jet of the full size, which shows very accurately what took place. The stream of water appeared to be very much pinched all round; it presented a somewhat irregular surface, and was very much divided at the end of its range.

In fig. 2, I have endeavoured to represent the currents which would appear to be concerned in producing this singular effect; it seems as if the particles of water striking against the flat surface of the cap were deflected towards the orifice from all sides, and pinched the jet so as to cause the contraction that was observed to take place.

In using branch-pipes of the usual taper form, when particles of air escape with the jet of water from the nose-pipe, a loud *popping* sound is always produced: but with the cylindrical branch, the noise in such case produced was strikingly different, being a *sharp cracking or snapping sound*.

Apparatus of a similar kind to the above has been tried before, but the singular phenomenon I have described appears to have escaped observation.

The issue of fluids from apertures of various kinds, under the influence of gravitation alone, with the nature of the currents supposed to exist, have been investigated by Newton, Bernoulli, Venturi, and many others, but the nature and properties of jets urged by great pressure, does not appear to have occupied much attention.

This subject offers a wide field for investigation; I shall avail myself of the occasional opportunities kindly afforded me of examining this matter, and communicate such new facts as may be elicited.

In the mean time, should any of your numerous correspondents have had the opportunity of noticing any facts bearing upon this particular branch of science, I shall be most happy to be made acquainted with the same through the medium of your pages.

I remain,

Yours respectfully,

WM. BADDELEY.

London, March 18, 1835.

PRACTICAL HINTS TO COAL-CONSUMERS.

Sir,—The degree of heating power possessed by coal varies with almost every separate locality. Some kinds give much flame, others but little; the variation depending on the relative proportions of hydrogen and carbon. Both the Staffordshire and the Cannel coal contain, especially the latter, a greater proportion of hydrogen than any other, and therefore give a larger flame, and are quicker in burning. The Newcastle, Yorkshire, much of the coal in the neighbourhood of Manchester, and some other places, possess a smaller proportion of hydrogen to their carbon, and consequently afford less flame, but are more lasting. The anthracite, or stone coal, large beds of which have lately been found in South Wales, is composed almost solely of carbon, and burns without flame.

All the kinds, however they may differ in their burning quality, are especially adapted to some useful purpose—indeed, it is scarcely possible to appreciate to its full extent the immense value of coal, its uses are so various and important. The mere bringing it to the surface for sale is supposed, by well-informed persons, to employ constantly more than 50,000 individuals; and the

quantity delivered annually from the coal-pits of Great Britain to exceed 30,000,000 of tons, the value of which, at those points, may be fairly estimated at above 10,000,000*l* sterling. More than 6,000,000 of tons alone are calculated to be consumed yearly in making iron. The coal brought into the port of London, during the last twelve months, exceeded 2,000,000 of tons, the cost of which to the consumers must have amounted to at least as many pounds sterling. It is, perhaps, not possible to ascertain, with any great exactness, the annual profit derived by the community from the various uses of coal; but if it were stated at 50,000,000 sterling, it would, probably, be far under the actual amount.

U. G. B.

ON MR. EXLEY'S NEW THEORY OF PHYSICS.—BY BENJAMIN CHEVERTON, ESQ.

Sir,—I beg to resume my reply to Mr. Exley, by noticing his observations which apply to my strictures on his theory of physics, and to crave indulgence for some further remarks to which it has given occasion.

Mr. Exley complains, that though I have passed encomiums on his theory of physics, "yet still Mr. Cheverton thinks it a premature attempt, although it may be ultimately successful. Now, if ['ultimately'] successful, why premature?" Precisely because I cannot admit that it is *at present* successful. There is a slight distinction here, which it is proper to observe. I do not say that it is premature *to make* the attempt, whatever I may think of the attempt itself. Let me illustrate my meaning. The true doctrine of the planetary motions was, in the days of Copernicus, merely an hypothesis, whose probability was founded only on its simplicity, strengthened by analogy. However proper it may have been to promulgate that system, it was premature and unconvincing, because mathematical science was not then sufficiently advanced to cope with all the difficulties in the way of its demonstration; nor were the data then procured, which were absolutely necessary to be known, ere it could be considered any thing better than a rational conjecture. Yet this attempt was ultimately successful in the hands of Newton, and could then no longer be considered as premature, because the fulness of time had arrived—in the perfection of knowledge, and in the attainment of the pre-requisite materials—when the philosopher could present the theory so complete in all its parts and proofs, as to force the unhesitating conviction of its truth. So in regard to Mr. Exley's theory of physics, it may possibly, in future time, be established by all the evidence of which the subject is susceptible, but at present it must be considered as *premature*—probable, but not certain—rational, but not convincing, and very proper to be made known, whatever may be its fate; because, if held loosely and provisionally as an *hypothesis*, to be confirmed or confuted by further researches made with a view to that object, it must prove highly useful in either case. "Any hypothesis," says Dr. Hartley, "which possesses a sufficient degree of plausibility to account for a number of facts, helps us to digest those facts, to bring new ones to light, and to make *experimenta crucis* for the benefit of future inquirers."

But Mr. Exley is, very naturally, not satisfied with this, by no means, unfavourable estimate of his theory. He says, "Now, if the writer does, with me, indeed believe that the numerous explanations of phenomena which I have adduced are really in accordance with the theory, then he must allow it is not premature; we cannot too soon get into the right path, or obtain a suitable guide." Mr. Exley must necessarily entertain a stronger conviction of the truth of his system than it is possible any one else can receive. He must, therefore, think it strange, and perhaps inconsistent in me, that while I admit it may be agreeable to nature to a large extent, so far as her processes have hitherto been traced, I profess, notwithstanding, to consider it as being premature, that is, incomplete, and as yet without sufficient demonstration. It is true, different minds require different degrees of evidence; but I fear the scientific world generally will not, with Mr. Exley, "be fully satisfied that the theory

explains clearly the several phenomena in chemistry, electricity, galvanism, magnetism, and electro-magnetism." Phenomena may certainly be explained, but in such an ingenious, inexact, and inconclusive sort of way, as not to bring conviction to the mind. It is not enough to show that things may take place in such and such a manner, but we want to feel assured that they cannot happen in any other. We want a confluence of proofs, converging in lines from different directions, ere we can entirely banish doubt. We want the "Instantiæ crucis," of which Bacon speaks, "to decide the question, by rejecting all the causes but one." By adopting exclusively the method of the mathematicians in strict synthetical form, Mr. Exley has precluded himself from that more satisfactory analytical proof. He has adopted certain principles, and by a course of reasoning, partly mathematical, erected thereon a goodly structure; he has wrought out, by dint of excessive thought, the various configurations which the elements should assume; and for proof that this is the veritable system of nature, he appears to rely solely on the accordance of phenomena as observed, with what should take place as educed from his theory. He reasons out the processes of nature, *à priori*, and seems to think that the only required evidence is their confirmation, *à posteriori*, by recorded experiments. It must be acknowledged that proof of this kind has great value, and when so extensive as in the present instance, ought to command very respectful attention. I am not aware that even the Newtonian system can cite in its favour any other species of evidence; but then, evidence of this sort is susceptible of degrees ranging between very wide extremes, and its strength is in proportion to the theory being definite and tangible, to the absence of postulates in the place of physical axioms, and to the paucity of minor hypotheses. Now, Newton's fundamental principles are facts and truths. Gravitation, whatever may be its occult cause (for in no hypothesis concerning which is the system founded), is a quality which comes home immediately to our notice; and the law of its action, to the extent of its decreasing in some ratio with the increase of distance, is demonstrable by experiment; whilst the chain of reasoning is connected with mathematical principles, which are the laws and conditions of certain motions and powers or forces. Here then is something to appeal to as an undoubted reality, cognisable by our senses, and scrutable to our reason. Well may this distinguished philosopher say, "I do not devise hypothesis." When, however, we turn from matter in the mass, which, in its entireties, in its actions and in its laws, is perceptible, to matter in its constituent atoms, which, in all these particulars is inscrutable, we seem to travel beyond the verge of our faculties and the confines of certitude. Hence, in the very nature of things, any theory concerning the intimate constitution of bodies, must be comparatively defective in the strength of evidence which can be adduced for it, as being more or less necessarily founded on postulates; and its explanations of phenomena must be more or less vague and unsatisfactory, as those postulates are more or less conformable to the simplicity and analogy of nature. The mere circumstance, therefore, of those explanations being in accordance with a theory, apart from the qualities of that theory, goes only a part of the way to establish its truth, or to redeem it from the character of being premature; for rival and opposite theories, and there have been many such, severally present their explanations and accordances, though they cannot all be right.

If, then, there be such inherent difficulties in the case, what ought to be done to give a theory all the evidence for its truth of which the subject will admit. It should be pursued and traced with as refined and exact a synthesis as possible, until cases shall be found which shall incontrovertibly flow from first principles, but which are not at present found in nature, and which shall be of that delicate and particular kind, which would render it very remarkable if they could be accounted for in any other manner. Let experiments be then instituted to see whether the effects can be brought about by natural operations, in the manner indicated by the theory. In proportion to their number, and to the peculiar conjuncture of circumstances which shall characterise these cases, will the theory gain in credit. Still evidence of this kind is only that of accordance, which, as before explained, is not wholly satisfactory in mere *hypotheses*,

since for aught we know the phenomena may otherwise be equally well accounted for. It is requisite, therefore, to have evidence derived if possible from *experimenta crucis.* For instance, Mr. Exley's system is inconsistent with the hypothesis which now so much prevails, of the undulatory nature of light. Now if experiments could be devised, whose results should render this supposition impossible to be true, the field would be greatly narrowed in favour of his scheme. Again, philosophers are divided on the question of the materiality of light, caloric, and other of the ethereal or imponderable elements, as they have been called. Now, if it could be indisputably proved that these are not merely certain properties of bodies, the evidence in behalf of his system would be immensely strengthened. On the other hand, it should be observed, that these experiments, though if in favour of it, would not be wholly conclusive, yet, if unfavourable, would be decisively fatal. If it could be further proved, that these elements are under the influence of gravity, it would furnish a fact highly favourable and important. There is, therefore, much to be done, according to my conception of what belongs to a philosophic estimate of things, before Mr. Exley's system can be regarded in any other light than an hypothesis; or if it must be called a theory, before it will lose the character of being premature, in respect (but in that respect only) to the present state of knowledge.

Let me, however, do Mr. Exley the justice to say, that there is nothing in his theory, nor in the present state of science, to entitle any one to pronounce confidently that it is founded in error—it can only be said that it rests on uncertainties, and that he has not yet sufficient evidence for its truth to justify the confidence which he manifests of his being "in the right path." The postulates to which he requires our assent are neither fanciful nor improbable, nay, there is every analogy in their favour. I say nothing here of the metaphysical part of the scheme, as not touching its real merits, but on which I shall have to say something presently. Let us pass these postulates under review.

(1.) Matter generally, perhaps universally, is known to be acted on by gravity, or rather, to act in a certain manner which we call attraction, and under the governance of a certain law. Mr. Exley asks us to admit the existence of the same force acting among the atoms at *insensible* distances, and regulated by the same law. Here is simplicity as well as analogy, for all other kinds of attraction, all the specific sorts invented to account for particular classes of phenomena, are superseded by the generality of this postulate. Here is simplicity in both its meanings, as the opposite of multiplicity and also of complexity. (2.) Repulsion between bodies is known to exist; he asks us to admit the same in respect to the atoms, and subject to a law similar to that of gravity. Here the law draws more on our imagination than the quality, inasmuch as there is not the same presumptive proof as in the case of gravity, arising from its existence in other circumstances. Still, if the materiality of light and caloric be admitted, there are certain experiments which will countenance the supposition. (3.) Impenetrability must exist somewhere and somehow; he asks us to admit of spheres of repulsion, which at their centres are impenetrable to each other, but only on account of repulsion being infinite thereat, because of the law of its increase. That is to say, the spheres of repulsion are mutually penetrable, but their centres cannot coincide. There is nothing improbable in this supposition. It has long been thought that the particles of body are not in contact. (4.) The force of attraction must belong to something, and in some sort of way. He asks us to admit the existence of an indefinitely extended sphere of attraction, as encompassing and resting on a sphere of repulsion, both together composing an atom of matter. Here the form or manner is more gratuitous than the forces and their common law. Still the simplicity of the idea, in which it is much superior to Boscovich's conceptions, rather recommends itself than does violence to our reason. Whether there be any central solid particle to which these spheres belong, that is, whether there be any substratum to these forces, any substance more occult, of which they are the sensible properties, or whether they have of themselves an independent being related only to space, are metaphysical subtleties which are left to the reader's judgment as not being a part of the phy-

sical theory. Mr. Exley's own opinion is in favour of the latter supposition, which removes, as I conceive, all substantial difference between him and the idealists; but I shall notice this point again. (5.) There must exist permanently essential differences in the elements of matter, else transmutation, uncertainty, and casualty would prevail, and individuality and identity would be lost; he asks us to admit of a variety in the extent of the spheres of repulsion, and in the intensity of their forces at a given distance from their centres. He cannot well ask for less, the other points being granted. (6.) The difference in the elements must be very great, either in kind or degree, since there are those which are called imponderable, and appear not to obey the influence of gravity: he asks us to admit of a very great difference merely in the forces of the atoms, but sufficient to produce a chasm and separate them into two classes, the common and the more subtile sorts of matter. This supposition appears to have more simplicity than analogy on its side, for it does not accord with that continuity in things connatural, which every where prevails; and yet to imagine a difference of the atoms in kind, such as would be marked by the presence or absence of the property of gravitation, would perhaps, on the whole, be less reasonable; for we have a better warrant to devise a law, or to imagine variations in the intensity of a force, than to invent qualities. In the former case, we are on the search for that which we know must exist, but of which we do not know its exact terms, or we modify that which is already known; but in the latter case, we create entirely anew, and assist our ignorance with a fresh category of things. The spirit of this observation may, however, be carried too far, as will be presently shown. Its propriety is manifest only within the great divisions or kingdoms of nature; and it is a want of sound discrimination in such points, and of an enlarged and enlightened view and estimate of things, which mark the mathematical in contradistinction and in opposition to the philosophical spirit of investigation.

The reader has now before him the fundamental principles embodied in Mr. Exley's two, and only, postulates, to which his assent is required, ere the author proceeds, by a most elaborate, ingenious, and admirable course of reasoning, to construct thereon his bold and remarkable theory of physics. It will be proper, however, to give them in his own language, together with the corollaries:—

"*Postulate* 1. Let it be granted that an atom of matter consists of an indefinitely small sphere of repulsion, which is the central part of an indefinitely extended concentric sphere of attraction; and that its force on the centres of other atoms every where within the compass of its action, varies inversely as the square of its distance from the centre, being attractive at all points beyond the sphere of repulsion, and repulsive at all points within that sphere.

"*Corollary* 1. At the surface of the sphere of repulsion there is neither attraction nor repulsion, but an opposition to an approach or to a separation; at all other concentric surfaces, the sums or total forces are equal: for these surfaces are directly as the squares of their distances, and the forces are inversely as the squares of those distances; hence the compound ratio is that of equality.

"*Cor.* 2. Hence the force, at the centre of an atom, is equal to the sum of all the forces in any spherical surface, whose centre is that of the atom.

"*Pos.* 2. Let it be granted that atoms may differ from each other, in the radii of the spheres of their repulsion, and in their forces at a given distance from their centres."

Every Newtonian who conceives of gravity as being an inherent property of matter, and is not content to base his principles solely on the physical fact, consents to all that is difficult in Mr. Exley's theory, and need not be startled at the form in which the article of his belief is there presented to his notice; for, led by the authority of names, and the influence of commonly received opinions, he has already drawn on his imagination to a greater extent than he is probably aware, and quite enough, if he be consistent, to warrant his admitting the postulates therein advanced. Whether he can go farther, and admit their sufficiency to explain all the phenomena of nature, is another question; but on a narrow scrutiny into the reasons of his own faith, he will find that *he* is not one

titled to reject them on the ground of their being speculative, and that his being indisposed to receive them, must be referred rather to the novelty of their position and application, than to the essential points they involve; or, what is still more likely, to their being as yet in want of the blazonry of authority.

The more cautious Newtonian, who, whatever he may *imagine*, has no *belief* ulterior to the mere fact, that bodies do gravitate; and, like his master, regards this as the sufficient corner-stone of the system, as a science, may be allowed to entertain more philosophical considerations on which *to suspend* his acceptance of this theory. Yet *he* would do well to remember, that the link which connects the heavens with the earth is analogy; that it is by inference only, even from the small and insignificant things which are within his control, he extends his conclusions to objects mighty and entirely beyond his reach, even the phenomena of worlds; and that the coincidence and accordance of observations and appearances with theory, do but confirm (irresistibly, it is true) a principle which is analogically derived—the universal existence of gravity. Faith, or a rational estimate of probabilities, enters more largely into the staple of science, and of what is called demonstration, than many are aware of, or at first sight are inclined to admit. Thus we believe, and have good grounds in the analogy and consistency of things to believe, that the influence of gravity is universal; but the universality is not a fact, it is only an inference from facts. For aught we can show direct proof for the affirmative, gravitation is not a universal condition of things, not even within our own world. In truth, the more energetic elements have every appearance of being exempt from such control; and if this be the case, in regard to some sorts of matter, it is *possibly* true of the celestial bodies. Or each of these bodies may have its own proper gravity, each varying from the others in intensity and in its law, and in such a manner that its sphere of influence may be so circumscribed, that they shall have no appreciable action on each other. The peculiarities of their motions must, in either case, be referred to some other physical causes, producing similar results to those which flow from the assumed cause; but the mathematical truths, it should be observed, as appertaining to the system of celestial mechanics, would remain untouched, receiving only a new application to a different physical construction of the universe, just as the mathematical properties concerned in the science of optics remain the same, whether we adopt the hypothesis of the undulation, or of the emanation of light. Such are among the possibilities; but we have every *reason* to believe that all bodies do gravitate, and with unlimited influence in regard to space; or, in other words, that the force of which we have direct experience, is *identical* with that which regulates the motions of the heavenly bodies, inasmuch as it would be gratuitous and unphilosophical to imagine the existence of any other. We have only to *suppose* that it acts according to the same law which, by another course of reasoning, is known to obtain in the planetary motions, and then all observations and appearances will accord with the idea, that the terrestrial and celestial force is one and the same, and has the same mechanical cause, if it have any cause which is mechanical. Or else, instead of reasoning from the earth to the heavens, we may *infer*, that bodies fall to the ground for the same reason that the sun and planets tend to each other. In either case there is a link of strict demonstration wanting, which is filled up with analogical and philosophical considerations. In regard, however, to the theory of the planetary motions, as involving the existence of a centripetal force, and of a law of decrease proportional to the square of the distance, a more complete demonstration is certainly possible. The first, or mathematical part of the proof, is founded on certain geometrical considerations, which establish the necessary existence of such force and such law as an abstract truth, and render their existence, in point of fact, inevitable, if observations and appearances accord with the conditions of the problem; and this accordance forms the second or physical part of the proof. Now the mathematical and the physical theme must necessarily run out into numerous ramifications, which, if the theory be true, must all be counterparts to each other; but the tracing and proving these was a

work of considerable time and difficulty. The evidence therefore was, and is in all such cases, progressive and accumulative, and the *demonstration* is not complete till the last step has been taken. In the mean time, the philosopher has to exercise his judgment, to value the evidence, to estimate the probabilities, to strike the balance, and to believe accordingly. He would not have shown a rational philosophic faith, had he refused his assent to the Newtonian system, even in the state in which it was left by Newton; and inexcusable would he have been, if, because of certain anomalies and uncertainties, he had made no efforts to strengthen or weaken the evidence for its truth. Now the circumstances are parallel in regard to the theory in question, both in the analogical and physical parts of the argument; and the Newtonian philosopher especially should be disposed to admit, what the simplicity and analogy of nature teach us, that a force may obtain among the atoms of matter, acting at insensible distances, which may be identical with the power of gravitation; and that a theory grounded on that supposition, and the assumption of same law of action, has only to adduce an extensive accordance therewith of observations and experiments, in order to furnish strong evidence for its truth. He will merely carry his own methods of procedure into another region of investigation. His faith at first will necessarily be weak, just as it happened at the first teaching of his own doctrine concerning the heavens; but it will strengthen as the evidence for the truth of the system increases, and it may ultimately advance even to a *moral* certainty, although, as in the parallel case in his own theory, there may be a chasm which only analogy can fill up. At present such confidence, I must again repeat, would be premature; and I would also not be understood to say, that it is probable the theories of the motions of matter in its masses and in its atoms, will at any time be equally certain, for that would be inconsistent with what was advanced in a former paragraph, concerning the natural inscrutability of the latter phenomena. The considerations, however, which have passed under review, should weigh with the Newtonian not to close his mind to conviction at the very threshold of inquiry, and to moderate his expectations of the kind and of the degree of evidence which *any* theory of physics can adduce.

(*To be continued in our next.*)

SAFETY APPENDAGE TO RAILWAY-CARRIAGES.

Sir,—Of the various accidents which occasionally happen on railways, those caused by waggons being thrown off the rails by sticks or stones laying across or *on* the rails, are the most numerous. Being on the Stockton and Darlington railway a few weeks ago, I saw an instance of the kind, but fortunately no harm ensued. A train of waggons, heavily laden, was proceeding at the rate of about sixteen miles an hour, when one of the wheels of the foremost of the train came in contact with a piece of coal, which happened to be laying on the plate, and such was the force of meeting, that the waggon leapt two or three inches high. Fortunately, however, it alighted in its proper position on the rails; for, had it gone off the way, such was the velocity of the other waggons, that they must have been inevitably dashed to pieces, and the person attending them either killed or severely wounded. As it was, no further damage was experienced, than a slight concussion, which was felt to the end of the train; owing to the first waggon losing time by leaping, and the rest overtaking and striking against it. Being an eye-witness of this *almost* catastrophe, it naturally made me try to devise some plan to remedy the possibility of accident on that head, and the following was the result of my cogitations. On each side of the first waggon of the train, I would have a kind of shovel fixed, so hung as just to clear the rail, that it may cause no unnecessary friction. Now, were a stone, stick, or any thing else, laying on or across the way, it would be an utter impossibility for the waggon to run over it, as it would not come in contact with the wheel. The shovel would either throw it off the rails or push it forward. Even if a man should fall across the road, as sometimes happens, instead of having his legs cut off, he would be thrown on one side, and be but little if at all hurt. This shovel might be hung by an adjusting chain, and in

cases of severe frost, or a slight fall of snow over-night, might be let down upon the rail, when it would prepare it for the progress of the vehicle.

I am, Sir,
Yours respectfully,
Wm. Pearson.

Bishop-Auckland, Nov. 4, 1834.

[Since the date of the preceding communication from Mr. Pearson, we have received another letter from him, in which he says:—"About two days after I had sent you my proposed Safety Appendage for Railway-carriages, an accident happened on the Stockton and Darlington railway, which I feel assured could *not* have happened had the plan there proposed been in use. The misfortune alluded to befel as follows: an engine, with a train of waggons, proceeding down the way at a rapid rate, came in contact with an old brake, which was laying across the rails, and by the concussion the engine was thrown off the road—the engineman (James Cleasby) was killed, his brains being dashed out against the water-tank, and much damage was done besides. The proprietors of the railway were so convinced that the brake had been designedly laid across the way, that they offered a reward of Twenty Pounds on the conviction of the miscreant who did it; but, unhappily for the cause of justice and humanity, the 'foul deed' has not yet been brought to light. On hearing how the accident occurred, I felt convinced that the appendage I have proposed would have prevented it. It must either have pushed the brake before the engine, till the engineer became aware of the impediment, or have eventually shoved it off the road! The wheel *could not possibly* have come in contact with it, and therefore the engine *could not* have been thrown off the road?" Two plans for the prevention of such accidents, very similar to that of Mr. Pearson, were proposed by Sir George Cayley, Bart., and Mr. Suddington, in our 15 h vol., p. 145. —Ed. M. M.]

STEREOTYPE SUBSTITUTES.

Sir,—A writer, in your Monthly Part for January, alludes to the probability of an invention by which the letters may be transferred from printed books to a kind of stereotype plates, by which copies may be infinitely multiplied, without a new composition or resetting of types. Chemistry will no doubt add this to the numerous obligations it has already conferred upon the world; and the printing once transferred, the Chinese, or indeed the lithographic printing, may satisfy us that the letters will be sufficiently in relief. The letter of your correspondent has suggested to me a question, whether lithography does not already supply us with a cheap mode of preserving a fac-simile copy of any types which have once appeared in the page of the printing compositor? What objection would there be to keep a copy of any printed page on transfer paper? Letter-press printing has long been successfully transferred to the lithographic stone, and if the copy taken off on transfer paper would keep for any length of time, we might, at very trifling expense, produce a few copies of a work whenever they were wanted. I hope some of your scientific readers, who have made chemistry their study, will be so obliging as to solve this question,—whether a copy made on transfer paper will keep for any length of time without being decomposed? In many cases the benefit to the literary world would be very great, from having the means of keeping (and renewing) a copy of a printed page, for immediate use, as type, in a space scarcely greater than that occupied by a printed book, and from it to have the power of producing copies, at an expense not worth any consideration, when compared with the cost of resetting the press.

I am, &c.
B. S.

MODE OF PRESERVING MILK FOR LONG VOYAGES.

Sir,—As the season of the year is now arrived when hundreds of mechanics are induced to cross the Atlantic, in the hope of bettering their fortune, and to those who may carry young families with them, milk may be an important article of diet, perhaps the following extract from an old newspaper of the date of 1822, setting forth a simple and easy method of preserving it, may be of importance; more particularly as I perceive from your last monthly list of new patents, that a method of preserving animal milk has just been patented—whether the same or a different method remains to be seen :—

"Provide a quantity of pint or quart bottles (new ones are perhaps best); they must be perfectly sweet and clean, and very dry before they are made use of. Instead of drawing the milk from the cow into the pail as usual, it is to be milked into the bottles. As soon as any of them are filled sufficiently they should be immediately well corked with the very best cork, in order to keep out the external air, and fastened tight with packthread or wire, as the corks in bottles which contain cider generally are. Then, on the bottom of an iron or cop-

per boiler, spread a little straw; on that lay a row of the bottles filled with milk, with some straw between each to prevent them from breaking, and so on alternately until the boiler has a sufficient quantity in; then fill it up with cold water. Heat the water gradually until it begins to boil, and as soon as that is perceivable draw the fire. The bottles must remain undisturbed in the boiler until they are quite cool. Then take them out, and afterwards pack them in hampers, either with straw or sawdust, and stow them in the coolest part of the ship. Milk preserved in this way has been taken to the West Indies and back, and at the end of that time was as sweet as when first drawn from the cow."

I am, Sir, yours,

J. ELLIOTT.

March 30, 1835.

THAMES TUNNEL.

Mr. Editor,—Many of the mining part of the public, of which I consider myself one, are anxiously looking for the recommencement of the Thames Tunnel; for it is an opinion common amongst us, that it is not altogether for want of money that it has remained so long in its present unfinished state. My firm belief is that the engineer dare not touch the end of the tunnel at all, by reason that the mud and water in the bed of the river are close upon the crown of the arch. Should that really prove to be the case, all the money in London will not finish the tunnel, on the present plan, and at the present level; if completed at all, it must be carried forward on a lower level, which would disfigure the tunnel, and disorder all that has hitherto been done.

It is not merely the proprietors of the Thames Tunnel that are interested in having the true cause of its not being finished cleared up, but the public at large; for there would probably be other things of the kind done, if it were only known that the failure of this tunnel has arisen merely from its being driven at an insufficient depth under the bed of the Thames.

The great Western Railroad, from London to Bristol, will be accomplished, no doubt, and why not continue it under the Severn mouth, near Chepstow, Monmouthshire, through Glamorganshire, and to Milford-haven, in Pembrokeshire? It would then traverse the coal-field of South Wales throughout its whole extent—a tract of country possessing also unexhaustible stores of iron-stone.

A tunnel was once proposed to be formed under the Mersey at Liverpool, and had it not been for the failure of the Thames Tunnel, would most probably have been carried into effect.

Mr. Brunel and his friends have always endeavoured to make the public believe that it is the difficulty of excavating under a great river, that is the cause of stopping the Thames Tunnel; while it is well-known to practical men that, whether the body of water is great or small, matters little, and that had Mr. Brunel only gone low enough, and made his calculations of earth and brick-work in a workman-like way, there need have been no difficulty in the case.

I am, Sir,

Your much obliged,

THOS. DEAKIN.

Blaenavon Iron-works,
March 6, 1835.

[The view taken by our intelligent correspondent of this sadly bungled affair, derives no small corroboration from the fact, that though nearly three months have elapsed since the Government loan of 247,000*l*. was obtained, the engineer is still only *making preparations to go on*. He finds, it seems, that he must have a *new shield* made before he can advance a step!—ED. M. M.]

DUBLIN AND KINGSTOWN RAILWAY.

The following is a statement of the number of passengers, of different classes, conveyed along this railway during the first quarter of a year since it was opened, namely, from the 17th December, 1834, to the 17th March, 1835:—

1st Class.	fare 1*s*. each	......	10.008
2d	ditto 8*d*. ditto	......	72.148
3d	ditto 6*d*. ditto	......	94.961
Total number of passengers..			177,117

The whole of this immense number of passengers has been conveyed without the slightest accident of any sort. The receipts, during the same period, have amounted to 5,283*l*. 16*s*. 8*d*. On these highly flattering results being made known in Dublin, the shares of the railway (100*l*. each, 50*l*. paid), which had previously been at 15*l*. (i.e. 30 per cent.) premium rose to 16½ per cent., and could with difficulty be procured even at that advance.

NOTES AND NOTICES.

Marine Wood Destroyers.—It was for a long time generally supposed that the *teredo navalis* had become quite extinct in the British islands, but within the last ten years it has again made its appearance in different places, and committed great havoc. It was first observed in the wooden pier of Portpatrick, on the western coast of Scotland; then at Donaghadee, Youghall, Dunmore, Island of Achil, and other places on the coast of Ireland. In league with the teredo, there is another species of wood-destroyer, nearly as destructive, called the *Limnoria terebrans.* The former consumes the interior of the pile, and to the latter the exterior falls a prey. At Portpatrick they threaten, by their united efforts, the entire destruction of all the timber in the pier. A piece of sound pine timber, which had been originally nine inches in diameter, when taken up, after being five years and a half used as a pile, was found so reduced as to contain not more than an inch in breadth of sound timber in any part, and in several places it was pierced entirely through. Mr. Stephen, the overseer of the harbour of Donaghadee, coated, by way of experiment, two sides of a piece of timber, with a common mixture of tar and sulphur, and the other two with white paint. The sides coated with the former were soon attacked by the *Limnoriæ;* but those which were painted remained uninjured. The most effectual method, however, of protecting timber from the teredo, which has been yet discovered, is to stud it closely with broad-headed nails, the rust from which soon covers all the wood, and shields it completely. The limnoria is not always, however, in league with the teredo, but is found in many places carrying on its ravages alone—as at Leith, the Bell Rock lighthouse, Kingstown (Dublin Bay), &c. A number of other interesting particulars on the subject will be found in the Edin. New Phil. Jour., for April, 1834, and Jan. 1835.

Caoutchouc Whips and Coffins.—I perceive in your No. 598, E. B. claims the invention of caoutchouc whips and whip thongs. I tried the experiment two years ago with caoutchouc in its raw state in thin slips, and also the thread plaited with cotton. E. B. will find that, owing partly to the solidifying influence of exposure to the weather, and partly to loss of elasticity, through the frequent extension, a whip made in this way cannot answer. About six years ago a solution of caoutchouc was applied to the crevices of some coffins to render them water-proof, and afterwards the cloth prepared with that gum was applied to effect the same purpose. I have no doubt but in a few years all coffins will be so made water-proof. Perhaps E. B. will oblige myself, and your readers generally, with HIS plan of applying the caoutchouc to coffins. Your constant subscriber, H. F., Jun., *Feb.* 4, 1835.

Decisive Proof of a Change in the Ecliptic.—The authors of the first vol. of the Fossil Flora of England, draw our attention to the singular fact, that the coal-mines of Canada and Baffin's Bay contain plants analogous to those of all other coal-fields, and consequently to those which now flourish under the equator. The difference of temperature, from that of the present day, may be attempted to be explained in different ways, and among others, by the gradual and continued refrigeration of the internal heat of the globe; but the authors of the Fossil Flora, with justice, remark, that the plants of equatorial countries require *light*, and that equally distributed, as much as heat. There are very few vegetables which can withstand the privation of light, for a few months. This is one of the causes which prevents the progress of plants of temperate regions towards the north, and which prevents them from thriving in the [illegible] greenhouses in high latitudes. [illegible] been the same with the fossil plants which are analogous to those of our equatorial regions. Besides, as the inequality of our days depends on the position of the earth to the sun, it would appear, that ere tree ferns could flourish where the [illegible] now is, the inclination of the ecliptic must have been different.—*M. de Candolle. Bibl. Univ., July*, 1834.

The Courier has declined inserting our answer to the letter from Mr. Hodgskin, which appeared in that paper, on the ground that it "relates chiefly to points of interest only to the parties concerned, and does not interest the public." We are afraid we must not dispute the want of public interest; but ought not the editor of the *Courier* to have discovered this a little sooner? Does he consider it fair practice, to open his columns to a slanderous and unprovoked attack on an individual, and then to refuse that individual an opportunity of justifying himself? He should either not have published Mr. Hodgskin's letter, or have been prepared to insert our refutation of it. Can it be that the editor has been turned aside from this plain course of duty by the circumstance of Mr. Hodgskin happening to be the said editor's assistant? Has compassion for his underling caused him to refuse justice to us? Fortunately, our own circulation is sufficiently extensive, to make us apprehend but little injury from the pages of the *Courier* being closed against us; but that does not make the endeavour of our contemporary to suppress the truth the less reprehensible. What though the publication of our letter would have shown Mr. Hodgskin to all the readers of the *Courier* (Lord Brougham not excepted) to be a person whom no honest or honourable man can have any "pleasure in knowing"? Must it not have been through an abuse of the confidence placed in him by his employers, that he procured his tissue of falsehoods to be inserted in the pages of the *Courier?* And would he have earned more than he richly merited, had he been held up, through the same medium, to public contempt and scorn?

Communications received from Mr. M. Potts—A. Z.—Scrutator Mechanicus—Rev. R. Carey—Mr. Clark—Emilius—Dr. Monson—Colonel Macerone—A Superficial Reader.

The Supplement to our present Volume, containing Titles, Index, &c., with a Portrait on Steel, of Samuel Clegg, Esq., C. E., is now published, Price 6*d.*; also the Volume complete, in boards, Price 8*s.* 6*d.*

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WHITE'S MODE OF SUPPLYING HIGH-PRESSURE BOILERS.

Fig. 1.

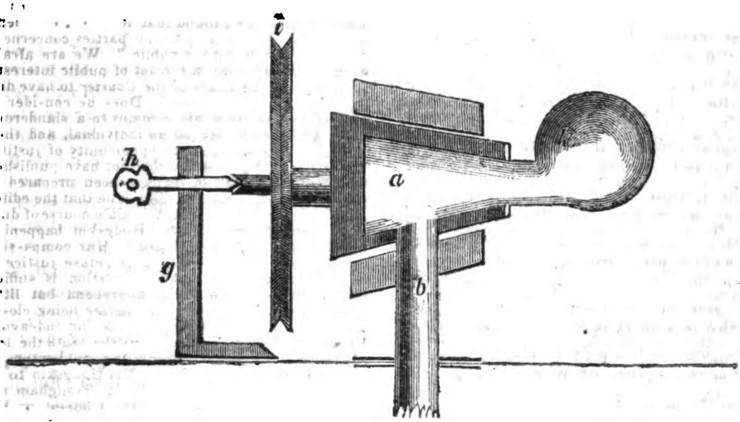
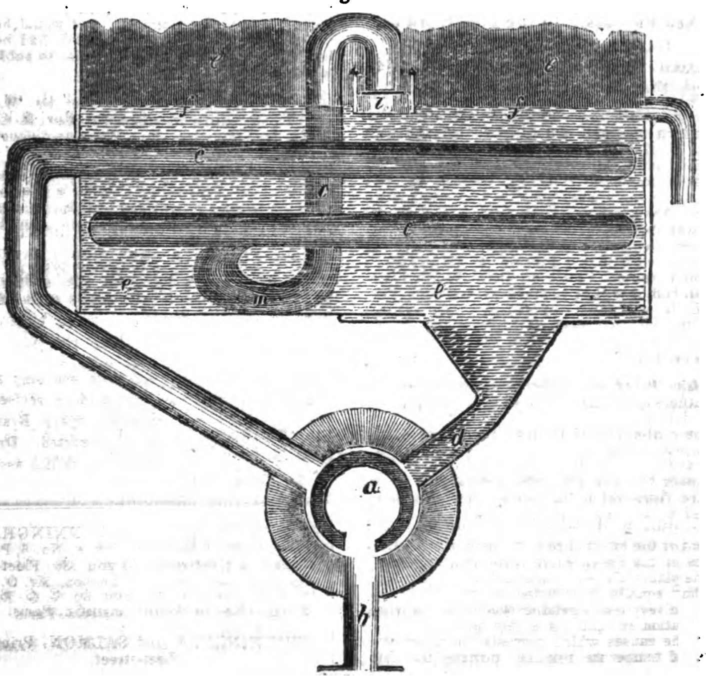


Fig. 2.



WHITE'S MODE OF SUPPLYING HIGH-PRESSURE BOILERS.

Sir,—The accompanying drawings represent a method of supplying high-pressure boilers with water, which seems to offer considerable advantages over the common method. No. 1 is a longitudinal section of the supply-cock; No. 2 a cross section of the supply-cock: *a* the plug; *b* a pipe from the boiler; *c c c* the eduction-pipe; *d* the water-pipe; *e* supply-tank; *f f* water-line; *g* an arm carrying the adjusting-screw *h*; *i* pulley-wheel turning the cock, acted on by the engine; *k* a copper ball.

The hollow plug and copper ball *a* are represented in the diagram as open to the boiler, and filled with steam. As soon as the plug opens on the eduction-pipe *c* the steam expands through its whole length, blowing before it the air and the water that may have collected in the part of the pipe at *m*, through the valve *l*, the spring of which is but little more than necessary to overcome the weight of the valve. The plug then arrives at the pipe *d*, where it is filled with hot water, which, on the plug arriving at *b* falls into the boiler, and its place is supplied by steam. The pipe *c c* is carried in a zig-zag direction twice through the water in the tank, forming two gratings, with a gentle declination; it is then carried up above the surface of the water, and ends with a short bend downwards, where it is closed by the valve *l*.

I am, Sir,
Yours respectfully,
JAMES R. WHITE.

Wells, Dec. 10, 1834.

ON MR. EXLEY'S NEW THEORY OF PHYSICS. BY BENJAMIN CHEVERTON, ESQ.

(Continued from our last Number, p. 13.)

Some observations ought to be addressed to those persons who are more enamoured with the *metaphysique* of a system, than with its facts. If discarding the notion of attraction being an inherent property of matter, and of bodies acting where they are not, the Newtonian of this class would, in imitation of his master, turn aside the veil which separates the known from the unknown, and enter the region of conjecture in search of the hidden causes of gravitation, he will probably find that he has only removed the difficulty one step farther back, and that he must still confer properties on matter; the very possession of which is equally mysterious with their nature, whatever we may imagine that to be. Is impulse and its mechanical action less a mystery than attraction? Who can say *why* one body in motion should move another by contact with it, and *why* in the same direction?—the effect is such, it is a property of matter, and that is all we know about it. And this property of repulsion—whence is it? Must we seek for its mechanical cause also? Or shall we be content to rest at this point, and say that it is inherent and essential to matter?—then why not stop short and say the same of attraction, for the difficulty is not greater? In both cases we can only say it is so, because it is so ordained, and in this wondrous act nothing can be strange—no one property can be more remarkable or difficult than another, for they are all alike the result of infinite power and wisdom, and all alike wonderful, without any degrees of comparison. But it is said, in regard to attraction, that bodies in this case must act where they are not. Who shall make it an axiom that they can only act where they are? Hath nature said it, or is it only the dictum of man derived from "the region of pure intellect"? If action is only communicable through actual contact, then, if distant action takes place, all nature is in contact, and consequently immoveable; or else corpuscular distance and motion must obtain, and then what is to prevent the gradual dispersion of atoms into universal space, or what can give them any assignable direction, but the influence of a cause which acts where it is not? All analogy, derived from the very general prevalence of antagonist principles, favours the supposition that the properties both of attraction and repulsion exist, and discountenances the probability of the phenomena under either head, being universally reduced to the other. Nevertheless, it is not absolutely impossible that *gravitation* should be reduced to impulse, and we need not, by any of the previous considerations, be debarred from the inquiry. It is only contended that the ultimate difficulty is still the same, and therefore, as at-

traction in a limited sphere may still exist as a property arranging the disposition of the atoms, that the Newtonian even of this school is not exempt from giving an attentive consideration to a theory of physics, merely because attraction lies at its foundation.

Though the preceding postulates embrace all the fundamental principles on which Mr. Exley's theory is built, it cannot be denied, that in order to make them apply to an explanation of phenomena in detail, various subsidiary hypotheses are introduced, for which no reason can be assigned but their convenience, and no proof but their fitness to make facts and theory accord. The impression which this produces on our minds, is that of the extreme ingenuity and elaborate artificiality of the system, and which makes us suspicious whether it be consonant to nature, and imparts to it the character of being a "world-making" scheme. It is matter of discussion, whether even the opposite practice of gratuitously multiplying first principles, by continually assigning forces and properties to matter merely to serve an immediate purpose, and explain only particular facts, or merely with a view to a partial scope and bearing, is more objectionable, or really more productive of complexity, than devising a general and comprehensive theory, whose pre-requisites are so few and simple, as to require complemental and particular suppositions for particular classes of facts, and in many instances for particular cases. Mr. Exley says, that "some difficulty must be allowed to have occurred in bringing so few and such simple principles to bear in the explanations," and that "it is not complexity but simplicity which characterises the operations of nature, in all their multiplicity, diversity, and grandeur." I would submit, for Mr. Exley's reflection, that the simplicity which characterises the *operations* of nature, does not necessarily arise from the *fewness*, whatever it may from the *simplicity*, of the first principles; for paucity is not to be identified and confounded with simplicity, any more than multiplicity is with complexity. It often happens that, by laying the foundation of things a little broader, we avoid the necessity of a complicated system of adventitious aids, and that by the admission of an additional principle, we are disencumbered of a variety of subordinate contrivances, which, in a plan on a narrower basis, are obsolutely necessary, in order to make it work. This is more obvious to the man of practical views than to the theorist, and may admit of many illustrations. Simplicity in *operation* is not more attributable to simplicity in first principles, than to a due variety of special original qualities, bestowed with a reference to given purposes, inasmuch as direct procedures are less circuitous than those which are indirect. The proper medium, the right combination of variety with simplicity of fundamental principles, in order to obtain the greatest simplicity in the operation and working of things, is the cardinal point of wisdom—to this point nature always attains, and it is our part to learn from her, and in our own doings to approximate thereto. "Her causes are few, her effects innumerable. Her course is the easiest and shortest possible, and her means the fewest that can possibly bring about her ends"—consistently, it should have been added, with that same easiest and shortest possible course, or, in other words, consistently with the greatest possible harmony and simplicity in the working out of results. But man will not learn of nature, he prefers rather to roam "in the region of pure intellect,"* and will twist and torture known but inapplicable principles to his purposes, sooner than wait the slow openings of experimental research, and by a patient, laborious, and extensive induction, discover the unknown principles which are really involved in his subject. The history of science has ever exhibited instances of this spirit, and never more strikingly, perhaps, than at the present day, when the physiologists profess to solve the phenomena of life, nay, even the phenomena of mind, on physical principles, and can allow themselves to talk of thought being a secretion of the brain, similar to a secretion of bile by the liver. Where is the philosophy, or rather, where is the common sense of supposing that the simplicity of the operations of nature is consulted, by eliciting them from so few principles as suppositions like these would indicate. It ought to be distinctly kept in mind, and

* My acknowledgments are due to Mr. Frend for this expression.

more so than the current phraseology of our language well permits, that to discard multiplicity is not to secure simplicity, which is not its opposite. To resolve all action, whether mechanical, animal, or mental, into one attribute of matter—communicable impulsive motion—or to make all the widely different elements to merge into one primeval form —or to sacrifice all the essential distinctions of animal existence, to a vague generalisation of the living principle, and evolve it in all its varied forms from a single original filament, or hypotheses, certainly, which are as obvious for simplicity, if paucity of first principles be only what is meant, as they are for being devoid of all appearance of truth and reality. Such simplicity has a charm for the mere mathematician and the theorist, because it brings a subject apparently, within the scope of his intellect, and gratifies his taste for orderly collocation and consecutive deduction, though the conclusions at which he arrives can possess only a seeming certainty, because the whole of that from which they flow is artificial and delusive. "Such a system," says Professor Sedgwick, for I must again quote this very appropriate passage, which refers to a subject that has often been treated in this eliminating method of obtaining simplicity,—"such a system may delight by its clearness, and flatter our pride because it appears to bring it within our narrow grasp; but it is clear only because it is shallow, while a better system may seem darker only because it is more profound." Let me not, however, be understood as intimating that Mr. Exley has indulged in any such wild conceits as those above enumerated —he has a better conception of what belongs to true philosophy. Still, the mathematical predilection for grounding his theory on very few and simple postulates, has, it is conceived, driven him to the necessity of feigning certain conditions, ere he can frame an explanation in accordance with his principles. Thus, with regard to the magnetical phenomena, there are many things assumed which it is difficult to admit or conceive. To the puzzling inquiry why, of all the metals, iron, nickel, and cobalt, are capable in any particular degree of becoming magnetised, we must be satisfied with this supposition for an answer, that the ethereal matter "must be capable of entering their surfaces to a very small distance, and by pressing and crowding the atoms of the body in its course together, must be incapable of making its way in a straight line, and this condition appears to belong to few bodies." The spiral channelling of magnetic bodies, by a current of ethereal matter gyrating about our globe in spiral lines, together with the local currents in these bodies, and the manner in which they produce attraction and repulsion, are all very difficult to conceive. These suppositions, however, are not more improbable than others that are current, particularly Amperes'; and they have the further advantage of being connected with a very general hypothesis. It is also worth notice, that they are countenanced to a certain extent by the spark which has been obtained from the magnet alone, since Mr. Exley's theory was published. The reader will do Mr. Exley great injustice if he should allow himself to receive an unfavourable impression of his most ingenious and elaborate work, from the above quotation, or, indeed, from any of the slight notices of it which this article contains. It will, doubtless, be referred to many years hence, as containing happy anticipations, in many particulars, of what will then be directly established by experiment. There is some reason to suppose that Newton himself was busily employed at one time in applying the property of attraction to an explanation of the intimate constitution of bodies, as he before had done to an explanation of the constitution of the solar system. Mr. Exley has now made the attempt, with what success time only can develope.

Mr. Exley has invited "any gentleman to point out a single fact, in any department of natural philosophy, which is not in accordance with the theory." I wish therefore to submit a few cases for his consideration. I cannot find that he has explained the expansion of water just previous to its temperature falling to the freezing point, but only in the act of crystallisation. He does not explain the welding of two pieces of iron together. This fact appears rather inconsistent with the theory, for he observes, that "when bodies are dry and warm, their surfaces retain much ethereal matter, *particularly caloric*, which prevents their junction;" and again, that "soon as the contact [of glass] is broken, they

ethereal atoms are diffused over the surface, and this *prevents* the union." It will hardly be said that the surfaces of iron in the act of welding are necessarily in a fluid state. In explanation of the explosion which follows the breaking off the tail of what are called Prince Rupert's drops, he does not advert to what I understand to be the fact, that this effect is produced only when the drops are made of the black-bottle glass, and which, if true, will make the matter much more difficult than it is already found to be. Let one of these drops be exploded in water, especially boiled water, and the side of the containing cup or glass will be forced out in a very remarkable manner. How is this effect produced?—has the liberated ethereal matter sufficient momentum?—or does it arise from the percussion produced by the fragments of the glass drop? Can Mr. Exley explain why the magnetic-needle is insensible to nickel at a certain very moderate temperature, and notwithstanding glass intervenes to protect it from any current of air produced by that temperature?—and why a plate of hardened steel has a magnetic influence only in fine lines, drawn in any direction on its surface with a pointed magnet? An explanation of this fact is to me inconceivable, according to the manner in which Mr. Exley supposes the communication of magnetism to take place.

There are two incidental topics on which, in conclusion, I wish to offer a few remarks. The first concerns the distinction between theory and hypothesis; and the second relates to some metaphysical ideas, suggested by Mr. Exley's notion of the constitution of an atom of matter.

(1.) Mr. Exley will perceive by the manner in which I have used the terms theory and hypothesis, that we differ in our opinions of their value. He says, that "the nature of an hypothesis is to explain only the facts which give rise to its contrivance; but a theory extends its influence to other classes of facts not thought of in its construction." I apprehend that the distinction between these terms, ought not to rest on their application being more or less general, but on a more exact and special difference of kind instead of degree. Thus I would use the term *hypothesis*, in its extensive signification, in reference to a system which is founded on postulates, whether gratuitously assumed, or analogically denied; but the term *theory*, I would apply to a system whose first principles are ultimate natural facts or truths, whether self-evident, or analytically traced through a course of observation or experiment. This is the broad primitive distinction; but it may be gradually lost as hypothesis merges into theory, by the postulates becoming gradually converted into fundamental truths. This is, I conceive, the proper philosophical use of the terms as applied to co-extensive subjects; but in a limited, and especially in a mathematical, sense, Mr. Exley's explanation of the term hypothesis is correct. In the mathematics, indeed, an hypothesis is not merely "to explain only the facts which give rise to its contrivance;" but it is, in general, a palpable invention by the mathematician, not to explain or investigate a series of complicated facts in their natural action and sequence, but to squeeze the subject within the narrow compass of his art and means. Nature is *feigned* to act in that way and manner in which the mathematician can follow her with rule and measure in his hand, and her actual proceedings are no otherwise regarded than as a guide to enable him to frame the imagined process, so as to produce similar effects. It is needless to say, it is only by chance, or by an especial after-contrivance, that the result can be the same; and hence, by a misuse or by an unguarded use of terms, it is commonly said that theory and experiment never agree. This consideration leads to a statement of the distinction in another manner. Theory admits not of anything which is known to be untrue; it is not worthy of the name unless it is conformable to nature as far as it goes. It may, however, be incomplete though not incorrect, and hence arise the frequent discrepancies between its results and those of experience; but when it comes to us perfect as a whole, these results must necessarily accord. How seldom this is the case it is not necessary here to say. Hypothesis, on the other hand, admits of suppositions which are only thought to be true; and, in the mathematical sense, it even admits those which are known to be false; but the latter case it *cannot* agree with practice; and hence experiments, or obser-

vations, on those subjects which admit only of hypothesis, must be the ultimate resort, if we would wish our conclusions to have any value. To this, indeed, we are generally driven, in reference even to theory, because of its incompleteness, or of the impossibility in most cases of comprising all the possible influences that are implicated in the final issue.

(To be continued in our next.)

ON THE PRACTICE OF THE BLOW-PIPE.

Dear Sir,—Among the numerous contributions which have at various periods appeared in your pages relative to the construction and management of blow-pipes, I have been surprised at not finding any directions for the practice of the *mouth* blow-pipe; an instrument far exceeding, in utility and convenience, all the artificial combinations which have been invented to supply its place. Thinking, therefore, a communication on the subject likely to prove interesting to your chemical readers, and calculated to promote the employment of this useful little instrument, I am induced to solicit your insertion of the following practical, though somewhat desultory, remarks, and am, Yours, very truly,

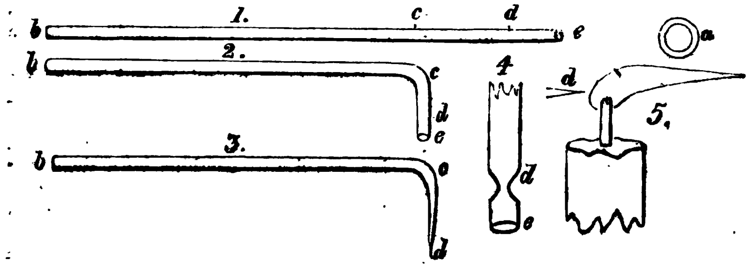
LIBERTUS.

Newington, March 9, 1835.

The introduction of the use of the blow-pipe in practical chemistry maybe regarded almost in the same light as the application of the power of steam to the purposes of commerce. If the latter has increased our national resources, and forwarded the interests of mechanical science, by economising the labour and expenditure which were formerly bestowed — the former has in like manner advanced the cause of chemistry and its dependent sciences, by reducing the expense of fuel, time, and material, which were originally required in qualitative analysis. If the mechanic can now produce, with comparative ease and expenditure, an article which, before the introduction of the steam-engine, would have required the labour of many weary days, and the consumption of much valuable material—the modern chemist can, with equal facility, detect the constituent principles of a body which, before the invention of the blow-pipe, would have called in requisition the unremitting exertions of many tedious nights, and the profuse employment of many rare and, perhaps, valuable substances. In fact, by the introduction of this simple, yet invaluable, instrument, the modern chemist can, by his parlour fire-side, and with a common candle, perform those operations, to accomplish which the ancient and less gifted philosopher would have been compelled to resort to the unhealthy atmosphere of a laboratory, and the continued poring over an intensely active fire. The blow-pipe, according to Bergman, had been long employed in the arts by jewellers and others, for the purpose of soldering, before it was applied to the purposes of analytical chemistry and mineralogy, by a Swedish metallurgist of the name of Sual, about the year 1733. This individual appears, however, to have left no written account of the methods which he adopted in its application. The researches of Cronstedt, Bergman, and Gahn,—and, more recently, those of Berzelius and Faraday, have concurred in raising this instrument to the eminent station of utility which it at present enjoys. In the work of Berzelius on this subject, will be found ample instructions for the pursuit of mineralogical and analytical chemistry; and in the "Chemical Manipulations" of Dr. Faraday, the student will meet with copious directions for applying this instrument in the bending and blowing of glass, in practical chemistry. For the former purpose, the mouth blow-pipe possesses undeniable advantages; but for the more fatiguing operations of the latter, the table or hydrostatic blow-pipe will be found convenient. The advantages possessed by the mouth blow-pipe over all those instruments, whose blast is produced by artificial means, consists in its portability, economy, and the facility of immediately suspending or modifying the blast. "The chemist does not possess," says Dr. Faraday, "a more ready, powerful, and generally useful instrument than the mouth blow-pipe, and every student should early accustom himself to its effectual use and application."

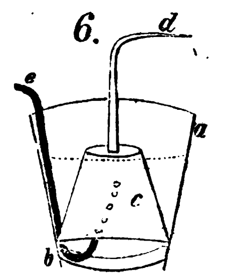
The supply of a *continued* stream of air is the chief difficulty which a beginner experiences in learning the use of this instrument; and this difficulty is, I apprehend, not unfrequently increased by the employment of a blow-pipe with too large an orifice, in the first instance. The following method of constructing

will, I have reason to believe, be found more efficacious than any other hitherto published, since I have by its means succeeded in less than half an hour in communicating the art of blowing to a class of several persons. Let the pupil procure a tube of glass, *b e*, about 13 inches long, and of the size and thickness of *a*. Let him now thoroughly heat the tube at *c*, about two inches from the end, by slowly turning it round in the flame of a candle, or, what is better, a spirit lamp. When he finds that it will yield, let him bend it gradually till it has acquired the position represented by fig. 2. The part *d* is now to be heated in the same manner, till it is found soft enough to draw out, when the part *e* must



be gradually withdrawn, as represented in fig. 4, till it terminates in a point; this point should be held for a minute or two in the point of the flame, in order to thicken it, and when cold, it is to be ground away with a file, until the smallest possible orifice is visible. The pupil will now be possessed of a blow pipe (fig. 3) with an exceedingly minute jet, and if he puff out his cheeks to the utmost, and place the end *b* within his lips, while the other extremity is held within a short distance of a candle (fig. 5), he will, after a few trials, find no difficulty in keeping the flame *continually*, and *without intermission*, horizontal and clear. The operation which he will be required to perform, in order to keep his cheeks constantly distended, notwithstanding the escape from the jet, cannot easily be described, but will naturally offer itself when the expenditure of air is very small. When the pupil has succeeded in keeping up a constant blast for several minutes by this means, he may enlarge the aperture by degrees, practising between each enlargement, till he finds he can manage a blow-pipe with a large bore, when he should purchase one of brass, with an ivory or tinned mouth-piece, for general use.

Among the numerous hydrostatic blow-pipes which have already appeared in your Magazine, the pupil who wishes to manufacture his own apparatus, may assuredly find one which will form a substitute for the table blow-pipe. I subjoin a plan for one, which may be constructed, at a trifling expense, by almost every student, and in situations where the articles or workmanship requisite for the construction of a more complicated machine could not be pro-



cured. A B is a common pail, about half filled with water; *c* is a large flower-pot inserted, and fastened in by any convenient method; *d* is a mouth blow-pipe (glass would do on an emergency), fastened in air-tight, with a cork and lute, to the hole at the bottom of the flower-pot; *e* is a bent tube of glass or metal, terminating under the mouth of the flower-pot. When air is blown in from the mouth at *e*, it rises into the body of the internal vessel and displaces the water, which, in endeavouring to regain its level, forces out the air from the jet of the blow-pipe, with a force proportioned to the height of the column of water displaced.

MY BROTHER.

Some Account of the Life and Literary Pursuits of Mr. Joseph Luckcock.

JOSEPH LUCKCOCK was born in Birmingham, Jan. 15, 1760. His father had been a manufacturer of that place on a small scale, and he inherited a little property from his father, but changed his occupation to enter into a partnership in the business of chemistry and refining of metals. This speculation, however, proved unfortunate. The trade became insolvent, and was broken up a few years after its establishment; and the poor old man, with a feeble constitution and depressed energies, never had the power to recruit the family fortunes, and of course the children had to struggle with difficulties to regain their lost rank in society. Joseph was an active and spirited lad. Early in life he displayed a capacity fit for the reception of mathematical knowledge. His schoolmaster (at that time the best the town contained, and whose pupils for many years averaged not fewer than 100), pronounced him the best arithmetical pupil he ever had: and some years after his drawing-master said, "I do not know whether I should be most jealous or proud of my scholar, for whenever he has finished a drawing from my pattern, I am a little puzzled to know which of the two is my own." On leaving school he was bound apprentice to his father; and here commenced that taste for the study of the sciences, and particularly the higher branches of the mathematics, which has since supplied the recreation and amusement of the remainder of his life. The attachment to chemistry, even at that early period, soon engrossed the most ardent powers of his mind, and by the union of practice with theory he became well acquainted with its principles and applications, in accordance with the knowledge at that time possessed, when aquafortis, oil of vitriol, caput-mortuum, &c. &c., were the terms in general use; for Priestley had not yet by his discoveries of the gases prepared the way for new theories and a new nomenclature. His favourite pursuit was, however, interrupted at the end of about two years by his father's failure; he was thus compelled by unwelcome circumstances to be bound apprentice a second time to a manufacturer, and he worked in the shop during the remainder of his minority. At the expiration of his apprenticeship he commenced on his own account the business of buckle-making, which he continued about twelve years, in partnership with his brother; when the whole of that branch of the wealth of Birmingham entirely ceased and became annihilated; and after paying 20*s.* in the pound to all his creditors, he was again cast upon the world without a farthing.

During this period, though his powers and inclinations were kept in full exercise, they were not limited to the dry and laborious studies already mentioned. He could well combine with them the lighter and more cheerful recreation of music; and in these opposite pursuits could he equally excel. He never, it is true, attained to any brilliancy of execution in instrumental harmony, for want perhaps of more leisure for practice; but he could read the most difficult compositions with a facility and correctness seldom surpassed by professional men, and with a degree of taste not often equalled by amateurs. A trifling anecdote may here be admitted as a digression. He had the mortification of witnessing the destruction of his favourite violincello, and the exulting mirth on the occasion, by the rioters at the Old Meeting-house in 1791; and this cast a damp on his musical raptures which was never afterwards entirely removed, as he never replaced his instrument by the purchase of another.

With many changes, which it would be ill-timed here to enumerate, he continued the next five-and-twenty years, chiefly occupied in concerns connected with the metallic arts; and the application necessary to provide for his subsistence prevented that devotedness to science which more leisure might have rendered highly serviceable to the world. About the year 1817, finding that by moderation and economy he had realized a few hundred pounds, he built his round cottage at Edgbaston, with the intention of retiring altogether from the bustle and selfish pursuits of society, and seeking his happiness for the remainder of his days, in the tranquillity of experimental gardening, and scientific efforts to enable him to keep pace with the rapidity of modern improvements. The spot he chose for his residence was

beautiful and somewhat romantic; his building was novel and picturesque; and his motto, borrowed from Ariosto, completed the harmony of the whole—"Parva sed apta mihi;" and some of his friends, in compliment to his pursuits, dignified it with the title of Orbit Lodge.

In this same year he published a *new theory of the tides*, with other matter; and if he had the mortification of its being but little noticed by the scientific world, he had at least the consolation that in no one instance was his theory controverted, or called in question: and considering the importance of the subject, and the capability he has displayed in its investigation, this silence itself places him on high vantage ground. It is impossible, either for an adept or a superficial observer, to follow the author through his train of argument, and his elaborate calculations, without admitting that he has brought to the subject a mind fully qualified for the investigation—that his assumptions are founded not on wild and empirical conjectures, but on sober reasoning, if not on absolute demonstration. It can hardly be expected, that the public should readily adopt any new discoveries in science which should spread an extensive injury through the community. The tens of thousands of books whose testimony must be cancelled—the numerous teachers and professors who would have to unlearn their favourite hypothesis, and the humiliating acknowledgment that they had all been in the wrong, all operate as a talisman, which demonstration itself requires a long time to destroy. It would be out of time and place to attempt, in this brief sketch, to vindicate his theory by argument—the object is not to gratify curiosity but to excite it. A familiar illustration will at once convey to the reader's mind, whether he be a man of science, or of plain uncultivated common sense, the power of forming a tolerably accurate opinion as to its truth or probability. Suppose a coach-wheel to be raised so as not to touch the ground, and made to revolve on its axis; it is obvious that all its parts converging to its centre would partake of the common motion, without any possible tendency to variation. But let the wheel rest upon the ground, and let the observer place a mark on the outer circle, and let the wheel be made to perform its evolution on its axis, and at the same time its advance on the road, and the mark will be found to have an accelerated or retarded motion, according as it may in rotation occupy the upper or lower part of its course. This idea, suitably amplified (he contends), will be found fully to account for and explain the cause and operations of the tides on the surface of our globe. Revolving on its centre solely, it could have no tides—but in conjunction with the advance in its orbit, and having such a mass of water on its surface, it could not be without them. Whatever plausible objections may be brought against this hypothesis, let them have fair play and their due weight; but let it at the same time be remembered, that there are many insuperable objections against the theory that would explain the tides by the attraction of the moon. The relative magnitudes of the earth and moon are about fifty and one. Supposing, then, that the moon's attraction of one can raise myriads of tons weight of water on the surface of the earth, and send them forward in a perpetual revolutionary protuberance—surely, then, the attraction of fifty on the moon, by a parity of cause and effect, would be sufficient to tear that globe in pieces, or inevitably drag it into the earth's vortex. The theory of attraction compels its advocates to contend or surmise, that those planets which have no satellites can have no tides; thereby excluding no less than twenty-one of the celestial bodies belonging to our system. If mere conjectures are allowed any weight in the argument, let them at least be on that side which corresponds the nearest with the apparent universal laws of nature. It is certainly a very unceremonious way of begging the question, to exclude so large a portion of that system from the beautiful analogy and unity of design, which, as far as our limited powers of investigation may extend, appear to pervade and sustain the whole. Not to multiply objections; we have the authority of Sir Isaac Newton himself, that gigantic champion of attraction—that "there must of necessity be, in the periodical return of the tides, some other mixed cause hitherto undiscovered"—these are his own words.

Mr. L.'s preface has the following unassuming and impressive passage—"I

launch my book on the stream of time; it is irrecoverable; it may be retarded in its progress by prejudice or misconception; it may founder on the quicksands of error; it may glide into the gulf of oblivion; but it is possible that it may reach the ocean of fair and lasting reputation."

In the year 1825, he published, in Newton's "London Journal of Arts and Sciences," a beautiful, ingenious, and complete calculation on the solar year, with a corresponding scale of adjustment with the variation of time produced on our earth, in consequence of the excess of duration beyond the 365 days. The excess of the six hours is provided for by our leap-year, but no provision whatever is made for the remaining time. The Julian correction of the calendar, at the time it was made, answered the intended purpose, but no plan was adopted for future regulations. Time passed on, till the discrepancy became considerable, and then the Gregorian attempt exhibited a second partial and imperfect knowledge of the subject. Eleven days added to the calendar at one time produced incalculable confusion in historic records, and in the legal and commercial transactions of the greatest portion of the world; and it was, after all, but a bungling effort to correct the cause. It was left entirely to chance, or caprice, or neglect, or misconception, to provide for the ever-returning difficulty. No individual, nor society, was responsible for any interference, and thus the subject remained in Cimmerian darkness. Eighteen centuries had passed away without any solution of the problem. The numerous *savans*, during that long period, ever on the watch to improve their wealth or their reputation, had passed it over, no doubt, as a solution impossible to bring within the power of calculation—or, if they did attempt it, were baffled in their endeavours. Some of the most skilful of them have been known to declare, that they did not think it practicable. What they totally failed in accomplishing, the subject of this memoir has attained, and with that perfection that fearlessly challenges the most elaborate and scientific scrutiny. He has exhibited the mode by which he proceeded in his calculations—and, till it shall be proved that he is wrong, he is entitled to that meed of praise which genius claims or expects as its gratifying reward. From his statement it appears that he has provided a regular and systematic scale, by which, at stated and uniform intervals, those portions shall be added that shall at length include every second of the supernumerary time, and bring the whole under the subjection of the most regular and beautiful harmony. Whether this plan will ever be adopted, has nothing to do with its merits as in present estimation. Time will do him justice—and it may not be long ere the name of Luckcock may form a trio with those of Julian and Gregory, leaving no opening for a fourth name, as the question will be set at rest; and his memory shall hold a conspicuous niche in the immortal temple of scientific fame.

In addition to these vouchers for his devotedness to philosophic lore, in the same journal in 1824, will be found a pretty full essay of his on the subject of light and heat; and he has a handsome folio volume, beautifully written, and containing numerous illustrative diagrams; the subject and subdivisions of which his own title-page will best and amply explain:—

"The Theory of the Universe; its certainties, its probabilities, and its mysteries; as far as the human intellect has hitherto been able to explain or comprehend them. Principally collected from the most undisputed authorities; but containing much original matter, and more particularly on Heat and Light—on Motion and Gravitation—on the Figure of the Earth—on the Calendar—and on the Tides."

Here is ample scope for inquiry; and even the failure of proof, on some of his speculative points, may be abundantly compensated by much original demonstration on others. It cost him the ardent application of the energies of his fitted mind during many years. When completed, many obstacles presented themselves to its publication, and time slipped away till the growing infirmities of age precluded any farther efforts on his part towards the accomplishment of his wishes. The work would be found, perhaps, too elaborate and expensive for a general school-book, too scientific for public reading, and the learned world could not be expected to feel an interest in its reception, till its merits had been fully discussed and recognised. For the present, therefore, it must remain in abey-

ance; but it would, unquestionably, be a valuable gem in the library of a man of wealth, of science, or of taste.

About seven years ago, finding that the most prudent economy could not enable him to subsist on his income, he sold his cottage for a life-annuity, on the produce of which he now chiefly depends. He has all his life been wedded to science; but if the expression is allowable, he never had any other wife. His inclination to studious habits kept him aloof from the frivolous pursuits of fashionable society, and even to a considerable degree from the innocent recreations that enliven and sweeten existence; and by his last retirement he became a perfect recluse from the busy haunts of his fellow-men. On these grounds it may well be supposed that he held no inconsiderable portion of eccentricity of character: this, his friends may not feel disposd to controvert, but, at the same time, they must warmly contend for the uniform consistency of his principles, and the sound integrity of his heart. In his theological opinions he is free and unshackled; feeling the firm conviction, that where the mind and affections are keenly imbued with the sentiment "whatever ye would that others should do unto you, do ye also unto them," there remains but little need for the adoption of any of those creeds which ever have and ever will be the source of strife and dissension among their professors. And in his politics, he is a radical in the best sense of the word —ever earnestly insisting, that every human being is inalienably intitled to his or her share of the general share of universal happiness. The portrait of Baron Cuvier, prefixed to his memorial by Mrs. Lee, is so extraordinary a likeness of the subject of this record, as thus to induce its attestation. Perhaps no chance effort ever displayed a closer resemblance, making a reasonable allowance for the difference of age.

Lastly, this communication is entirely unknown to him whose encomium is intended. It is presented in high admiration of his talents and character, and as a tribute of warm affection from

His brother,

JAMES LUCKCOCK.

Lime Grove, Edgbaston.

"EXPOSITIONS AND ILLUSTRATIONS, INTERESTING TO ALL CONCERNED IN STEAM-POWER." BY COL. MACERONE.*

We expected, about this time last year, that when we should next have occasion to discuss the steam-carriage exploits of Colonel Macerone, it would be in the shape of a defence to a certain action for libel brought against us by the Colonel; but *diis aliter visum*. Col. Macerone has very civilly intimated to us, that he has no intention of proceeding with the action, and this too of his own free grace and favour—wholly unasked, unsolicited, unsupplicated by us. Not (of course) that there was or could be any doubt of the Colonel's coming off the winner had he chosen to go on with the suit—nor yet that he had any idea of putting up tamely with our strictures upon him—but that he had bethought him of a far more sensible method of refuting us, than any to which the peddling firm of Messrs. John and Richard Doe could help him.

"Away," he cried, "with such ignoble tools;
With Brettel's aid,† *I'll print and shame the fools.*"

The principal point, it may be recollected, on which we were at issue with Colonel Macerone, regarded the possibility of his steam-carriage having "actually run 1700 miles without a single shilling being required for repairs." We said, that we did "not believe" it had done any thing of the kind; and willing to let the Colonel off as easily as possible, we suggested that he had in all probability "been deceived by others" into making so extravagant a statement. The Colonel would not, however, be let off; he re-asserted the 1700 miles performance as a thing perfectly within his own knowledge; and rejected, with disdainful glee, the supposition of his "being deceived by others out of the evidence of his senses." We asked for proofs—"plain matter-of-fact" proofs—not big words; but no such proofs were ever forthcoming, and there the affair rested at the time the Colonel so politely invited us to take a turn with him in Westminster Hall.

In the Pamphlet *vice* Declaration, which Colonel Macerone has now served upon us, he begins with a formal re-assertion

* Effingham Wilson. 8vo. Pp. 126. 1835.
† "Brettel's Aid." — See "Expositions and Illustrations," p. 105.

of the truth of the disputed statement; and, as if there were not already enough to swallow, raises the number of miles from 1700 to 3000!!!

"I *can* produce the most competent testimony to prove, that I have run one carriage 3000 miles WITHOUT ANY SENSIBLE WEAR AND TEAR EITHER TO THE BOILER OR ENGINE."—p. 11.

Further on he repeats the statement with a little more circumstantiality:—

"I declare that the same identical carriage delineated in the frontispiece of this work,* which took Mr. Gordon to Windsor, &c., and which has since run through every journey spoken of or alluded to in this work, and many scores of others, besides several weeks' daily work on the rough bad paved roads of Belgium, at the rate of twelve miles an hour, IS NOW IN AS SOUND A STATE OF BOILER, ENGINES, AND MACHINERY, AND IS, IN FACT, MORE EFFICIENT THAN THE DAY (8th Sept., 1833) it first took Mr. Gordon to Windsor, since which it has run at least 3,000 miles." —p. 33.

But although the Colonel says he "*can* produce the most competent testimony to prove" all this, still he produces none. He gives, indeed, a great many extracts from books and newspapers, descriptive of particular performances of his carriage—some very genuine-like private letters also; and he furnishes, moreover, a list of fifty-four persons—noblemen, ambassadors, generals, members of parliament, engineers, editors, reporters, &c., who either have attested, or are ready to attest, the reality of these performances, to all, or any, of whom the Editor of the Mechanics' Magazine is politely told that he "may, if he please, *give the lie*." It is by no means necessary, however, that the Editor of the Mechanics' Magazine should do any thing so uncivil, in order to make good his charge of exaggeration against Col. M. The present is not, as the Colonel would fain represent it to be, a case of conflicting authority—a host of positive testimony on one side, and a single, solitary, stubborn disbeliever on the other. All that these witnesses have affirmed, or are prepared to affirm, may be perfectly true, and yet the position of the Editor remain entirely undisturbed. The question we have raised is not whether the Colonel's carriage has evinced its capability of going ten, fifteen, twenty, or any number of miles per hour; but whether, admitting all that is alleged of its rate of going to be correct, it has actually gone (as Col. M. alleges) the 1700 miles (we need not insist on the "3000") "without a single shilling being required for repairs." Our words were these:—"*That* is far beyond what can be said of any other steam-carriage that has yet appeared on the road; and if literally, or even substantially, true, it settles at once the only material question which remains undetermined with respect to the economy of steam travelling—*namely, the question of tear and wear.*" (Mech. Mag., vol. xx. p. 165.) Now, all the evidence (with an insignificant exception) which the Colonel now brings forward, goes quite beside this—the *only* question. Of his fifty-four witnesses, there is but one who ventures to back his 1700 mile story—by "opinion" too, merely, not knowledge—and that is Mr. Alexander Gordon, the ready backer of all persons of out-of-the-way pretensions—the Cochranes, Gurneys, and Corts, of the age. "For this assertion," says Mr. Gordon, "Col. Macerone has been much written against by parties who never went to see his carriage. My own *opinion*, formed after narrowly watching and riding much upon his carriage, is, that it has done, and can do, more work than 1700 miles without repair. I do not, nor do the proprietors, assert that, after running such a distance, it *required* no repairs. I knew, and Colonel Macerone never concealed, that it does *require* repairs." Indeed, Mr. Gordon! Did our eyes, then, deceive us, when we read, in the Colonel's first pamphlet (*Facts concerning Elementary Locomotion*, p. 27), these words,—"The carriage has actually run 1700 miles, without a single shilling being *required* for repairs" (the very words!)? Did they also deceive us, when we read in the same pamphlet, page 32, these other words:—"This I know, and can also prove, that we have run our steam-coach above 1500 miles, *without* EVER HAVING HAD OCCASION *for the slightest repairs whatever, either to the machinery or the boilers.*"? No—our eyes did not deceive us; there both passages are still, as boldly prominent and as absolutely unqualified, as ever. Neither will Mr. Gordon be at all deceived, if he read in them as flat a con-

* Also in Mech. Mag., No. 539.

tradiction as any backer ever yet received from his principal.

Hitherto we have contented ourselves with stating that we "did not believe" the Colonel's 1700 miles without-occasion for-repair story—for which disbelief our reason was simply, that the statement was of the nature of a physical impossibility. We can now, however, venture to go a step further, and to assert, on the strength of testimony of the most direct and unexceptionable kind (testimony, to which Colonel Macerone at least will not except), that the statement is positively false. Who does the reader imagine is the witness we intend to produce? He will hardly credit us when we name Colonel Macerone himself! Yes, incredible as it may appear, the same Colonel Macerone who in 1833 affirmed there had never been "a single shilling *required* for repairs," never any "*occasion* for the slightest repairs," and who commences his pamphlet of 1835 by asserting, that even now the carriage is "*without any sensible wear and tear,*" actually "*in as sound a state*" as when first started, is the identical witness out of whose mouth we mean now to show, that it was all the while scarcely ever out of the hands of the tinker—often knocked up entirely through parts of the machinery giving way—and is now in a perilously crippled and shattered state! The following are extracts from the pamphlet now before us:—

"THE AXLE HAS BEEN BROKEN FOUR TIMES."—p. 33.

"The consequences of the *four* interruptions occasioned by these breakings of our axletrees, *have been more distressing and injurious, and paralysing, to me than I have space to describe.*"—p. 34.

"That the carriage has *often*, and *for a long time together*, *required* repair, as Mr. Gordon has it, is *very true*. My poverty has obliged me to run with wheels *which would hardly hold together*. The casing of the boiler, and of the ash-pit, *will burn and rust through*, and I have had them with *as many patches and holes* as there may be in a beggar's garment. The frame has been *strained and sprung* by the screw-jacks and levers. The body of the carriage has been *wrenched, and cracked, and disfigured*. The fire-bars have at last been burnt to the thickness of my finger, *so as to let the fuel through into the ash-pit*; but still the carriage has run as well, at an average of fourteen miles the hour, and far better, through better management, than when entirely new; the boiler and engines are as good as ever, and are so now; so that I will venture any wager, that this same carriage, just as it is, *with its old shattered frame*, and after the shaking it has had on the Belgium paved roads, which is more than equal to twelve months' work on the worst roads in England—I will, I say, wager to run that same carriage, on English roads, 5000 miles more consecutively, without any other repairs than what may be required to the casing of the boiler, the fire-bars, or the wheels. *I am speaking of the carriage to which all the accounts in this pamphlet refer.*"—p. 34.

We need make no comment on these extracts. Col. Macerone elsewhere attempts to explain how so much evil fortune has befallen his carriage—ascribes it all to untoward and accidental circumstances, and ventures to promise that the like shall "not happen again." We are not called upon, however, just now to discuss the validity of the Colonel's explanations, or the value of his promises. We want not to know why the carriage should have stood in need of so much repair (reasons enow suggest themselves), but why Col. Macerone should have sought to deceive the public, by so repeatedly and solemnly affirming that it stood in need of none whatever. The case, as Col. Macerone (not Mr. Gordon) chose to put it, was, that his carriage had actually run 1700 miles without being a shilling the worse; that case we undertook to demolish; and having demolished it utterly and for ever, there we shall now leave it.

There was a little episode about Mr. Ogle and the boiler. We stated (Mech. Mag. No. 545), that Mr. Ogle, when asked the reason for his apparent retirement from the field of locomotive competition, replied that "he had lent his boiler to Colonel Macerone, and that it was with this boiler all the Colonel's recent performances on the Edgware-road were performed." Colonel Macerone pronounced this to be "an impudent and malignant libel," and threatened "legal proceedings against the responsible parties." We replied, that we had "but repeated a story which Mr. Ogle had made current all over London, and that if *justice* were all he sought, he could be at no difficulty in determining who the *properly* responsible parties were." Neither, we may here add, did we repeat

the story from any purpose of mere annoyance, but for this better reason, that it seemed to throw, for the first time, some light on the 1700 mile without-occasion-for-repair story, of the entire want of foundation for which we were not then fully aware. That we gave any heed to Mr. Ogle's story arose entirely from the state of doubt and wonder in which the much bigger story of Colonel M. had previously left us. The Col. now admits (p. 55) that he had heard of "Mr. Ogle's barefaced pretence," and "from that gentleman's own lips" long before we took any notice of it. Why, then, did he not direct his "legal proceedings" against Ogle? Why fasten on the mere second-hand circulator of the libel (which it does now appear to be), when the author of it was on the spot to answer for himself? Was it—*could* it be a love of truth which dictated so evasive a course?

Col. M. complains much of the little encouragement he has received from the public in his steam-carriage speculations, compared with other projectors. The whole of his pamphlet, indeed, is in the nature of an *argumentum ad misericordiam*. "The other steam-carriage projectors," he says, "have *all** had their twenties, and thirties, and forties of thousands put into their purses, even before they had a moving thing to show. I had to struggle on in the midst of actual want and destitution," (p. 91.) Again, "Numerous negotiations had been overthrown by unforeseen accidents, quite independent of the running of the carriage, *which never failed* (!) Constant penury—absolute distress—never able to endure the expense of long runs—only one carriage—*no patronage*—continual arrests—executions for rent and taxes, &c."—p. 95. And further on: "I am now sans money, sans factory, sans men, sans carriages, and sans any thing."—p. 101. "It may be probably asked," he says, "why I have given in this pamphlet such particulars of personal distress and difficulties? I answer, that it is only by doing so that I can show how it has happened that, *with so complete and triumphant an invention, I have not succeeded in doing any thing with it.*" The same reason which Col. Macerone here gives for obtruding his "personal distress and difficulties" on the public attention, must be our apology for touching on so delicate a subject. For, "it is only by so doing," that we can arrive at good grounds for judging how far he is entitled to the benefit of his conclusion, that it has been owing altogether to want of pecuniary patronage, and not to any defect in his carriage, or in the system of common road steam travelling, that he has come at last to such a stand still.

Col. M. admits, in the course of his pamphlet, that he and his partner have received, on account of their steam-carriage speculation, the following pecuniary aids:—

	£	s.	d.
From Mr. F. C. Parry, who "provided me with the funds for taking competent premises, purchasing lathes, tools, and establishing a factory on the Paddington Wharf," (p. 90) sum not stated, but certainly not less than......	500	0	0
From "a foreign gentleman a small sum, with which we set the factory clear of arrears, and *completed a carriage*," p. 90.	?		
From Mr. Odell, Mr. Todd, Mr. Hallmandel, and Mr. G. Rahn, sundry "small sums," p. 92.	?		
From a "wealthy gentleman, without chick or child," p. 92	100	0	0
From the "purchaser of a share in the profits of the business," p. 92			
Mr. Squire's portion thereof	1,100	0	0
Col. Macerone's	?		
From "the person who lent me 100*l.* to defray the expense of taking the steam-carriage to Birmingham" (where it was never taken), p. 101	100	0	0
From Colonel Asda, p. 101	1,500	0	0
	£		

The blanks in this list leave a doubt as to the total amount of the sums received by Messrs. Macerone and Squire, in the course of their two years' steam carriage career; but we do not suppose we shall run much risk of exceeding the truth, if we say that it amounts to full 4,000*l.*!!!

* All! There are but two, or at most three, persons, of whom this can be said with any truth—Mr. Gurney, Dr. Church, and Mr. Russel.

A pretty commentary this on the tale of "want and destitution"—"constant penury"—"no patronage," &c. Although we may not dispute the reality of Col. M.'s distresses and difficulties, we are at least entitled to maintain that they were not occasioned by any want of funds to carry on his steam-carriage speculation. The money obtained on this account, by the Colonel and his partner, was far more than sufficient to command success, if success had been attainable. For the 4,000*l.* received by them, all that they have to show are two carriages, worth, according to Col. M.'s own valuation, 800*l.* each, making, together, 1,600*l.*; leaving 2,400*l.* (surely ample allowance) to cover the extraordinary expenses of the concern.

What, then, may the real cause of the failure of Col. M.'s steam-carriage speculations be? Can we infer less than that there must be some unacknowledged difficulty in the case, which no pecuniary help, nor any extent of public patronage, can overcome?

Col. Asda, the purchaser of the two carriages, has taken them over to the Continent, and has been exhibiting them there, but hitherto to no better purpose than Col. Macerone did here! If all is right with the carriages, how is this? Has Col. Asda, too, his tale of penury to tell?

One word more before we conclude, as to our motives for speaking as we have done of Col. Macerone and his steam-carriage performances. He accuses us of "a most unaccountable, wanton, and ferocious disposition to calumniate and injure" him (p. 101). We are really not sensible, however, of entertaining the slightest acerbity of feeling towards him; and have yet to learn when or where we have evinced the "ferocious disposition" he ascribes to us. We would gladly have spared him, if we could, consistently with our duty to the public—and it was not (as he knows well) till after many importunities, that we overcame the reluctance which we felt, to say what we honestly thought of his steam-carriage pretensions. When we did take notice of them, it was with mildness and forbearance; nor did one word more escape us to his prejudice, than a regard for truth absolutely demanded. We have since been obliged to apply the lash a little more smartly; but if persons, when clearly shown to be in the wrong, will persist in crying "liar!" and "slanderer!" it is but what they should expect—to get well lashed for their pains.

SUBSTITUTE FOR CANAL LOCKS.

Sir,—A short time since, I read an extract from the *Taunton Courier* (the date and particulars of which have escaped my memory) which announced the opening of some branch canal in that part of the country, of about four miles in length; on which canal, machines called "*lifts*," said to have been invented by Mr. Green, the engineer, have been introduced, in lieu of the present mode of lockage. Now, if I mistake not, a similar machine was invented as many as twenty years ago, and actually brought into action by a person of the name of Woodhouse. But whether Green borrowed the idea from Woodhouse, or Woodhouse from Green, it is impossible for me to say. I know it was considered at the time quite a new thing. However, it was found not to answer the intended purpose, being too complex, and too expensive, for universal adoption. I should be highly gratified if some of your numerous correspondents would produce a drawing and description of one of these "*lifts*," for insertion in your journal; and I am sure there are hundreds besides myself who would be equally gratified.

If I might be allowed to state an opinion, I should say this mode is *inferior* to the old mode of *lockage*. Twenty or thirty tons is a weight which must require machinery of an immense strength and power to transport from one level to another, often differing from six to eight feet; and, as a natural consequence, the time lost must be considerable—much more, I should imagine, than by the present mode of *lockage*. To be sure, in short water seasons, like the last, they would be found highly valuable, as at such seasons loss of time is nothing, compared with a saving of water. The past has been a trying season for canals, and the expense incurred by many of the companies has necessarily been very great. I have been told it has cost some of them as much 3*l.* *for every lock of water!* and that, too, for a *considerable length of time!*

I am, Sir,

J. L.

Bulbourne, March 22, 1835.

NOTES AND NOTICES.

Mrs. Somerville on Monday last received an autograph letter from Sir Robert Peel, informing her, in the most delicate style of compliment, that the knowledge of her acquirements in science had made it his duty to submit to his Majesty, the propriety of granting to her a pension on the civil list of 200*l.* a year. Mrs. Somerville's letter of thanks was accompanied by a present of her book. The day following she received a handsome acknowledgment for the book, with an expression of regret that it had lost the charm of novelty, as he had already read it in the first edition.—*Times, April 7.*

Collision of Carriages on the Dublin and Kingstown Railway.—On Saturday morning last, as the Vauxhall locomotive was passing the engine-house yard, on her way from Dublin, with a single carriage in train, loaded with timber, she came violently in contact with the Dublin, which was coming out of the yard at the time for her day's work. The shock was so violent that both carriages were thrown off the rails, and the Vauxhall, going fender foremost, went right through the wall on the south side of the road. Fortunately, however, no lives were lost; and after a delay of no more than three hours, the carriages were again at work.

Railways in France.—The French minister, M. Thiers, presented last week to the Chamber of Deputies a project of law relating to railroads. He announced that the Government engineers had fixed upon three principal lines for railroads—one from Paris to Havre, by St. Denis, Pontoise, and Gisors, with branch lines to Rouen and Dieppe; a second from Paris to Lyons and Marseilles; and a third from Paris to Lille, Bourdeaux, and Strasbourg. Surveys have, it appears, been made, and plans drawn out for these several lines; but one only, that from Paris to Havre, is recommended to be at first undertaken. It is proposed to throw open the work to public competition, and to entrust it to any company who will offer the best conditions, and sufficient securities. M. Thiers further proposes that the Government should adopt a system practised in America, by taking shares, in the enterprise on the same footing as private shareholders; and that the Government should subscribe to it to the extent of twelve millions of francs (500,000*l.* English).

A Railroad from Athens to the Piræus is stated by the *Munich Journal* to have been contracted for by the Greek Government with the banker Fereldi.

The Menai Bridge.—A friend of ours, who lately crossed this bridge, was informed, by a gentleman who resides close to it, and has erected standards by which to mark the degree of vibration to which it is subject, that, during the late violent gales, it was on several occasions so much agitated as to oscillate to the extent of eight feet six inches—that is, four feet three inches both ways, out of the straight line. We believe, however, that even a much greater rate of oscillation than this was allowed for in the calculations on which it was constructed.

Portsmouth and Gosport Floating Bridge.—The Admiral-superintendent of the Portsmouth dockyard, Sir F. L. Maitland, having, by orders from the Admiralty Board, instituted an inquiry into the merits of the project (see Mech. Mag. vol. xxii. p. 208) for forming a floating bridge between Portsmouth Point and Gosport (to consist, like the one at Little Hampton, of a platform to be worked to and fro by means of a drag-chain sunk across the harbour), has reported that the navigation of the harbour would be exposed to material injury from such an incumbrance, and that it is, therefore, undeserving the countenance of Government. As the harbour is the property of the Crown, the project may therefore be considered as at an end.

Artesian Wells employed to actuate Machinery.—At Frontes, near Aire, the waters of ten Artesian wells (springs obtained by boring, and so called from the province of Artois, in France, where this method came first into extensive use) put in motion the wheels of a large mill, and act besides on the bellows and forge-hammer of a nail-manufactory. At Tours, a well, of nearly 150 yards in depth, pours 225 gallons per minute into the troughs of a wheel seven yards in diameter, which is the moving power of an extensive silk-manufactory.—*M. Arago, Annuaire*, 1835.

Steel Pens when first introduced cost 70*s.* a gross; the same quantity is now manufactured for 4*s.* About 120 tons of steel are annually used in this manufacture, each ton producing 1,900,000 pens. In France and the United States attempts have been made to rival us in this branch of art, but wholly without success.

Calculating Machine.—A gentleman, who is known to us, and for whose scientific ingenuity we can readily vouch, has requested us to state, that he will engage to furnish for a sum of not more than 40*l.* a calculating-machine, having three orders of differences, of five, four, and three places of figures respectively, and capable of calculating any table whatever of six places of figures, with the third difference constant. He will ask no money till the machine is delivered perfect according to the above objections; and would not object to bearing himself half the expense, on condition of retaining a corresponding interest in the machine.

Velocipedes.—Mr. Editor, Your "Country Subscriber" may procure a velocipede at 7, Nelson-terrace, City-road, London, where they are manufactured when ordered. I do not know what Baron Drais' principle is, but these are made with two wheels, one following the other. The wheels are entirely of iron, and there is no wood about them but the handle, the elbow-board, and the body. I am, Sir, yours, &c, ALEX. CLARK. —*April* 2, 1835.

J. W. W. cannot expect that we should publish such a statement as his on anonymous authority.

Communications received from Mr. Ireland—Philopopulus—Scrutator Mechanicus—A Subscriber—R. C. W.—Mr. Buck—Mr. Henderson—Mr. Murray.

The Supplement to our present Volume, containing Titles, Index, &c., with a Portrait, on Steel, of Samuel Clegg, Esq., C. E., is now published, Price 6*d.*; also the Volume complete, in boards, Price 8*s.* 6*d.*

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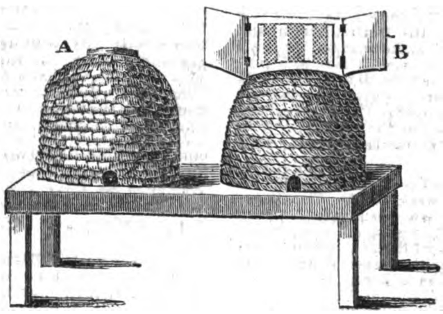
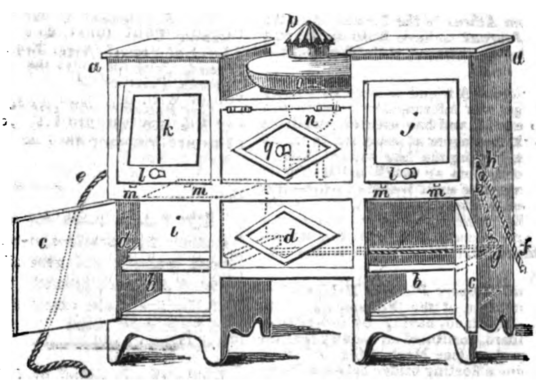
REV. CHARLES DEWHURST'S BEE-HIVE.



POPE'S SLIDING SHIPS'-COMPASS.



REV. CHAS. DEWHURST'S BEE-HIVE.

Sir,—I have much pleasure in forwarding you an extract from a lecture delivered, a short time ago, before the members of the Verulam Philosophical Society of London, by its late Secretary, Charles Dewhurst, Esq.; and if you think it likely to interest your readers, I shall feel gratified by its insertion.

The lecture I alluded to was on the Natural History and Management of the Hive or Common Honey Bee (*apis mellifica*), wherein the lecturer detailed a humane and successful plan of securing the honey without depriving the bees of life, which is now generally adopted in the county of Suffolk, and originated with his father, the Rev. Mr. Chas. Dewhurst, of Bury St. Edmunds. The method employed by this gentleman is as follows:—

"The hive he avails himself of is similar to the one used by the cottagers, with this exception, that it has an opening in its roof of about four inches in diameter; this has a moveable top (see figure A), which is pegged down whilst the bees are at work and filling the hive. As soon as the latter is full, Mr. Dewhurst (when the bees are absent) carefully, with a knife, separates the top, and places in its stead a wooden box, of about eight inches square, having doors and a glazed front (see figure B), in order that he may view, from time to time, the progress they have made in their work. As soon as the bees have filled this box with honey, it is removed, and another substituted; and by repeating this process, immense quantities of honey and wax may be obtained, without the least loss or injury to the community. In one year Mr. Dewhurst obtained no less than sixty-three pounds of fine pure honey by this method."

I remain, Sir,

Your obedient servant,

HENRY W. DEWHURST,

President of the Verulam Philosophical Society of London.

March, 10, 1835.

P. S.—I may add, that Mr. Dewhurst protects his bees from the weather, robbers, &c., in a neat constructed house, about twelve or eighteen inches from the ground.

POPE'S SLIDING SHIPS' COMPASS.

Till of late years, ships' binacles were almost universally furnished with two compasses, in order that, on whatever side of the ship the steersman at the time happened to be, he might obtain a direct view of the compass. But in small binacles this inconvenience happened—that the needles of the two compasses mutually attracted each other, and thus introduced an error, often of very serious magnitude, in the indication of the compass. This circumstance is noticed in a work on the local attraction exerted by the iron in a ship on the magnetic-needle, published in 1820, by our friend and correspondent, Mr. Lecount, at that time a midshipman in the royal navy, who recommends that the compasses, when two are used, should never be placed at a less distance than 4 feet from each other.

In some large ships, this cause of error is partly avoided by the use of two binacles, with a compass in each; and in one or two instances a binacle with a single compass has been used, the entire binacle being made to slide in a groove from side to side of the ship, so as to suit the convenience of the man at the helm.

In 1832, Mr. W. Pope, of Bell-alley, Cornhill, fitted on board the East India Company's ship, Charles Grant, a sliding compass, which, according to the report of the agent to the owners, is a great improvement on the common binacle. The Society of Arts have also signified their approval of it by presenting the inventor with 5*l.*, and have given the following description of it in the last Part of their Transactions:—

"Mr. Pope's binacle is stationary, being made externally like a common double binacle with a window on each side of the lamp; but instead of having two compasses, he has only one, which is placed in a shallow rectangular box, which has a cord inserted at each end, and led out through a hole in each side of the binacle. The width of this latter is just as much more than that of the box, as to allow it freely to traverse from one side to the other by pulling one of the cords; and there are two grooves in which the box moves, in order to steady it.

"In the prefixed figure, *a a* is the binacle; *b b* its floor; the two doors *c c* being opened to show it; *d d* a square board, with a raised edge round it like a tray. To this board

are attached the two ropes *e* and *f*; these ropes pass out of the binacle round the pulleys *g*, there being one at each end. These pulleys direct the ropes to the guide pulleys *h*, by which the ropes are raised high enough to be always ready for the helmsman's hand. The rope *e* has been pulled, and has brought the sliding-board *d* to that side. On this board stands the compass-box *i*, within the edges, so that it cannot slip off. On pulling the other rope *f*, the compass *i* will be brought to that side: *j* and *k* are the right and left windows, through which the compass is viewed. These windows fit in their places something like coach-windows. To take them out, they are lifted a little by the knob-handles *l l*, as they are only held in at bottom by the short pins *m m*; their bottoms are then pulled forward and lowered out. A lamp with two burners is hung in gimbals in the middle, so as to light both ends of the binacle; it is shown by dotted lines *n*; above the lamp is a square copper neck, to which is fixed the oval copper top *o*, so that air can go in between them; the smoke goes out at *p*. The knob *q* serves to raise the middle flap, which is hinged at top for the purpose of getting at the lamp."

MR. M'CURDY'S PROPELLER—CRANK-MAKING.

Sir,—Mr. M'Curdy, a description of whose propeller you gave in your 607th Number, states one of its advantages to be "cheapness of construction." Now, the principal part of the apparatus consists of two very complicated quadruple crank-shafts—of wrought iron, of course—and crank-shafts, as all engineers are aware, are things of very difficult construction. Mr. M'Curdy's cranks, too, would require to be made with almost mathematical precision, so that the one should work easily with the other. The cost of such propellers must necessarily, therefore, be very great. To give your unmechanical readers some idea of the care and trouble required in crank-making, I will state the process as described to me by a very ingenious practical mechanic. A bar of the very best iron, free from all flaws and defects, is chosen; it is made red-hot in a forge, and at the place marked for the first elbow it is cut nearly through, and bent up; this leaves a vacant square corner, into which must be welded a piece of iron, of a corresponding size. This is an operation of great nicety, as particular care must be taken that the whole of the surfaces are welded. It often happens that the outer edges only are welded, while the central parts of the surfaces remain quite separate; when this is the case, the crank, of course, soon gives way. The same process is followed with each elbow, until the crank is complete. How greatly, then, must the difficulty of the operation be increased, when it is required, as in the case of Mr. M'Curdy's propellers, to make four cranks at different angles out of one bar of iron? There would be *sixteen* elbows in each crank-shaft, into each of which a square piece of iron would have to be welded—that is, beaten, when red-hot, with hammers until the piece inserted has amalgamated, and become one with the bar. There would, of course, be just so many chances that the flaw I have before mentioned (the central part of the surfaces not joining) would occur.

The constant breaking of the crank-shafts of steam-carriages has been one of the causes of their failure on common roads—and one of the principal features in the machinery of Russell's was to do without this troublesome piece of mechanism.

I have said nothing as to the originality of Mr. M'Curdy's contrivance, which is more than doubtful.

I am, Sir, &c.

SCRUTATOR MECHANICUS.

March 30, 1835.

STEVENS' PADDLES.

Sir,—There is no doubt but that the plan proposed by Mr. M'Curdy, in your 607th Number, would ensure the perpendicular action of the paddles, and thereby offer some advantages over the common paddle-wheel; but I think it would be found, in practice, that parallel cranks are a piece of mechanism exceedingly difficult to adjust, and still more so, to keep in working order. The South Sea paddle is also very unmechanical, and by no means suitable where space is of any importance.

The paddles patented some time since by Mr. Stevens, which were very fully described in your ninth and tenth volumes, are very similar, in their action,

to those now proposed by Mr. M'Curdy. Mr. Stevens' contrivance, however, offers the greatest advantages, without being liable to similar objections.

I cannot conceal the surprise I feel that Mr. Stevens' invention should have been suffered to fall into such apparent oblivion.

The experiments made by Mr. Stevens, in the City Canal, and elsewhere, were of a very decisive nature, and although they might not be admitted to have fully established the vast superiority of his paddles over those of the ordinary description, still they were sufficiently conclusive to warrant their adoption by any person seeking to improve to the utmost the highly important science of steam navigation.

The machinery of Mr. Stevens' paddles is exceedingly simple; it is capable of great nicety of adjustment, and the action is so beautiful, that I guess it will be a pretty considerable long time before we are favoured with any other contrivance, for the same purpose, possessed of equal merit.

Among the various experiments which Government have instituted in many of their steam-vessels, I regret that Mr. Stevens' paddles have not been fairly tried; and I cannot help thinking that something more than common accident has prevented Mr. Stevens from reaping the just reward of his ingenuity and skill.

I remain, Sir,

Yours respectfully,

WM. BADDELEY.

London, March 31, 1835.

ON MR. EXLEY'S NEW THEORY OF PHYSICS. BY BENJAMIN CHEVERTON, ESQ.

(Continued from our last Number, p. 22.)

(2.) It has been already noticed that Mr. Exley considers an atom of matter to consist of concentric spheres of repulsion and attraction, without any *solid* extended particle in which they inhere, or have their subsistence, inasmuch as all the properties of bodies, including that same solidity and extension, may, he says, be derived therefrom, without the supposition of such particle, and that, therefore, to imagine its existence, is useless and gratuitous.

This is the doctrine of the existence of power without a substratum—of properties, or qualities, without any matter to which they belong, and consequently it is the doctrine of the *spirituality* of the universe. Properties, or qualities, are certainly only the different manifestations of power as severally operating upon us through our senses, and it is of this power only, in its varied forms, as affecting us through the several mediums of access, of which we can be sensible, or have any discernment. That something must have a being to which such power belongs, is, it must be allowed, only an inference of our reason, and without having much to reason from, and yet we unconsciously, as it were, come to that conclusion, it being probably as much derived from an intuitive feeling on the subject, as from the mind's reflection on its own operations. Of this, however, we are certain, that such *substance* must necessarily be unknown to us; that the powers upheld by it, and directed therefrom upon percipient beings, is alone cognizable; and that the impressions thus produced constitute the whole of our knowledge concerning external nature.

There is another very different doctrine, which supposes matter to have an existence as a *substance*, distinct from that which it has as a power supported by that substance, and which allows you to conceive of the former as having a real being—a created being it is true—whilst, as if afraid to concede so much in regard to the latter, it refers its activity and manifestations to the continual and immediate exercise of the Divine power. According to such views, matter is conceived to exist without any power proper to it, or as essentially belonging to it, and is regarded merely as the medium of the Creator's energy. Now unless we are prepared with Spinosa, to identify the substance of matter with the substance of the Deity, the former must be thought of, as having, though not an independent, yet a perfectly distinct and separate existence from that of the Divine Being; and if we will not admit that the power which this substance supports, has also such distinct and separate, though not independent, existence, then these two, the substance and the power, must be thought of as being distinct and separate from each other. Here, then, we have the doctrine of sub-

stance without power, and we have just taken notice of Mr. Exley's doctrine of power without substance, both of which I apprehend are indefensible.

Now there are other two doctrines, which, though directly opposed to each other, are consistent with themselves, and into which I consider the two just mentioned objectionable doctrines ought to merge; but in regard to those, I am not called upon to offer an opinion as to which of them is the most agreeable to the little light which nature and reason have thrown on the subject. The first considers, as before, that power constitutes matter; but then it regards this power as not having a distinct and separate existence from the Deity, but that, in its varied manifestations addressed to percipient beings, and regulated and modified in conformity to what are called the laws of nature, it is still the *immediate*, the instituted, immutable, working of that all pervading intelligent energy, in which we move and have our being. This is idealism. The other doctrine considers matter to be a real entity, which has power essentially belonging to it; that it has a positive existence, both in regard to its substratum and the power which it supports; that this power is in an especial manner distinct and separate from that which is divine; and that this being admitted, it cannot *be* without a something in which it inheres, or with which it has been associated by the will of God. It is submitted that the one or the other of these doctrines is only worthy of our belief, if we be concerned to entertain any belief on a subject so far removed from the reach of our faculties: but though we are not entitled, in this particular case, to dogmatise as to what is the truth—for it is probably not within our powers even to conceive of or apprehend it — yet we may be allowed to judge of pronounced opinions, whether they be absurd, inconsistent with themselves, or lead necessarily to others which were not contemplated, and which would not be admitted. For, in such an investigation, we have to deal not with the mysteries of nature, but the dictates of man's wisdom. Let us, then, examine the two opinions first stated as being objectionable, with a view to show that we have no rational alternative but in one or the other of the opinions last stated.

1. Let us first take the last mentioned of those doctrines—namely, of substance without power. Numerous passages might be quoted from the writings both of philosophers and divines in illustration of it; but the following, as containing a very broad and explicit avowal of it, must suffice:— "Seeing that in God all things live and move, as well as have their being; seeing he is not only the *primum mobile*, containing the whole frame of creation, but likewise the inward sustaining, acting principle, indeed the only proper agent in the universe, unless so far as he imparts a spark of his active, self-moving nature to created spirits, &c." Locke also considers matter to be only passive, and spirit alone as being active. If such be our views of the relation which the Deity bears to matter, we ought, I conceive, to proceed further, even to the extent of saying that the idea of any other, save percipient existences, appears not to have a place. For where is the necessity—at least it is not apparent to human apprehension — that *substance* should have an existence merely to sustain the workings of a power which does not essentially belong to it, the active *virtue* of such substance, being according to such views, the flowing forth of the Supreme unoriginate energy, which surely may proceed at once to its object, and which seems to need no conduit or medium for the efficiency of its high purposes. It is as easily conceivable that the efflux of such power, in accordance with ordained laws and sequences, may have its course *immediately* as *mediately*, and in strictness of conception it does so come forth by the very hypothesis, and matter appears only either as a pretence for its exercise, or as a subterfuge in the designation of its *being*, by that term, to save us from the grossness of Spinosa's views. Nay, it is stated in express language by philosophers of this class, that there is no such thing as the course of nature, or the power of nature, independent of God's *immediate* agency. They thus admit all that is prominent or important in idealism; for, abstracting such agency, the utmost conception which remains of matter confessedly makes it destitute of all virtue and efficiency, and there is left only an unreal mockery, a mere pretence, or an occasion (in our own thoughts,) for the exercise of that divine power, which alone makes it what it appears to us to be. To give

it a real existence, they must identify it with the substance of the Deity, and as this alternative is only to be mentioned to be dismissed, they must either yield to Berkely's doctrine of its non-existence, or take refuge in a mere nominal distinction, to save them from that abhorred extreme, which, whilst flying from in one direction, they come round so near to in another. To designate the being of matter by that name, is not to confer on it a real existence, whilst we refuse to assign to it any thing better than a name; nor is it otherwise than by the subterfuge of another name, to distinguish it from the Deity, if we refuse at the same time to consider it as a nonentity. Supposing, however, matter to have some strange, virtueless, ineffective, inconceivable sort of being, by refusing to it a proper efficient causality, they at the same time deny to it even all instrumentality towards the production of an effect, for the one negation is implicated in, or is a necessary consequence of the other, in a case like the present, which mounts up to the spring and source of things. The notion which remains of matter as a distinct existence, considered as apart from the Divine Power, through which, by the supposition it is alone active and qualitative, is not sufficient to dignify it as an instrumental cause, for not having an agency of its own, it has no powers which the Supreme and directing power can *use*. The Divine Being is supposed to provide at once the efficiency, and the intelligence which presides over and guides it; there exists, therefore, nothing wherewith to act, nothing that can interpose as a secondary cause, or subordinate agent, between the Deity and his creatures, and thus in a sense more peculiar and emphatic than these philosophers will admit, "God is all in all." The doctrine, however, to which they object, only comprises their own sentiments under another aspect, or contemplated from another point of view, and enunciated in other terms. Admit again, for a moment, this notion of matter—of substance without power—and we may observe that the virtue by which we realize it, has only a contingent existence, an existence depending on our perceptions, it being manifested only when it becomes manifest to us—it not having an inherent, ever-present existence, but being an act of the Creator's power, determinable by the will of the creature! But can we even form a conception of a state of being whereto belongs not power essential to it, or which is only the conduit or intermediate channel of power between that being to whom it properly belongs, and those which are its objects, for the utmost idea, or notion rather, which we have of body, is of something the unknown support of certain powers, of which, abstractedly therefrom, we can conceive absolutely nothing—and even of its very existence only as a notion, in the way of inference from those powers. If, then, we divest that something of that which is its only expression, and by which it is only known to exist, nothing whatever remains for our contemplation, nothing of which we can conceive, and out of which we may constitute, or from which we may infer an existence—nothing actual at least, for neither the literal nor the ideal symbol of a nonentity mustbe allowed to impose itself on us for a reality. Such terms as substance, medium, mattter, channel of communication, &c., are in this hypothesis necessarily without meaning, for conveying, as we have seen, neither an idea nor a notion, they are the symbols only of negation; but unhappily they obtrude in the place of clear and explicit conceptions, and cheat us into the delusion that we are discerning and resting on something real.

To contend for the existence of such inert and powerless matter, is not only to assume what is inconceivable, or if conceivable, what is wholly superfluous and inoperative; but, to take it in another point of view, it is to limit Omnipotence, as though it were more difficult to endow with power than with existence. Power *can* be imparted, it can exist as the proper attribute of substance, distinctly and separately, though not independently of the Deity; for we, as intelligent, living, and powerful creatures, are not only instances of its possibility, but of its actual existence, and the *kind* of substance to which it is imparted cannot constitute the difficulty. It cannot be more easy for Omnipotence to endow spirit than matter, with their respective peculiar powers. For the substratum, and the power which it upholds, proceed alike from the Author of *all being*, and his will, to give existence to either, necessarily supposes their mutual adaptation, for that will

confers adaptation on whatever it conjoins. We can seek no criterion of fitness in the nature of things, but must ultimately refer all rule and standard to the origin of things. To imagine a difficulty, is to imagine an independent existence, to the nature of which, in the contemplation of endowing with attributes, intention and design must conform; in which supposition, certainly, the idea of possibility and impossibility is admissible, though we may not be entitled to pronounce thereon; but when we allow that substance and power are equally the result of creating will, all ground for argument on natural incongruity and impossibility, is given up, seeing that the nature of things is *made* to be what it is, and that congruity can have no other criterion, can be referred to no higher source, than the will which constituted it. Metaphysical subtleties, therefore, are utterly inadequate to enable us either to affirm or deny, by *à priori* reasoning, concerning *any* powers which *any* substance can support; and when we would reason on things as we find them, our entire ignorance of their essence, precludes alike all dogmatism on the subject. I am aware—what, indeed, has been already mentioned—that Locke regards matter as being essentially inert, as being only passive, and spirit alone as being active;* but if substance in any case is, as he allows, quite unknown to us, we are by our ignorance of its nature rendered incompetent to perceive an incompatibility with the attribute of power, in one order of being more than in another. Nay, the very distinction into orders or kinds of being, rests on and is determined by the different powers which they possess, and not on any thing which we know of their substance. That the differences in their attributes is immense, is very apparent; that the difference extends in an equal degree to their essences, is conjectural, but highly probable. The power which belongs to intelligent natures, is of a higher order than that which it is contended may be the attribute of matter. It has permanent authority over the latter, ruling and modifying it in its various operations. It has also its own peculiar province, and its manifestation, in whatever manner, is not of necessity but springs forth from volition. It works vast changes in the face of nature, being a *creator* of differences if not of things. Material power, on the other hand, has a constrained action, and all its operations are inevitable consequences of its original constitution. The changes and fresh combinations which are wrought out by it are also vast and incessant, but they have no immediate origin; they own no spontaneous, no irregular course, they deviate not from the path in which they were first appointed to run. If, then, a created substance claims in its own right, and for its own proper keeping and developement, the superior power, what difficulty is there in admitting that another created substance can be endowed, in its own right also, with power of an inferior kind, of a necessitated, blind, and unerring action, if the Divine Author of both should see fit. These things are only equally wonderful and mysterious, for we have no ground on which we can rest a comparison, but if any difference be made, we ought more readily to allow the existence of the lower order of power, which distinguishes unwilling, unintelligent nature. On these several grounds, therefore, I consider the doctrine of the existence of matter, unaccompanied with powers that are properly and essentially its own, to be untenable.

2. Let us now advert to the opposite doctrine—of power without substance. This doctrine denies the validity of the inference previously mentioned, of the necessary existence of the latter as a substratum for the former. This is, in other words, the notion of the independent existence of *properties*; for, as I have before observed, power is so called when spoken of, not abstractedly, but in reference to the kinds of perception by which it makes itself manifest to us. Now to conceive of properties in this manner is very difficult if not impossible, and is alike alien to our language as to our thoughts, the one being the result of the other. This will appear if we speak, for instance, of motion, and ask what it is the motion of?—and we must answer, of extension, of solidity, and of the other properties, including even mo-

* These terms were not used by Locke, merely in the sense of saying, what is sufficiently obvious, that matter is devoid of an originating self-moving principle, but to assert that it is so essentially powerless, that any appearances which may indicate a contrary opinion, must be referred to its being acted upon, or to an action through it by a more potential nature, of which alone activity is an attribute.

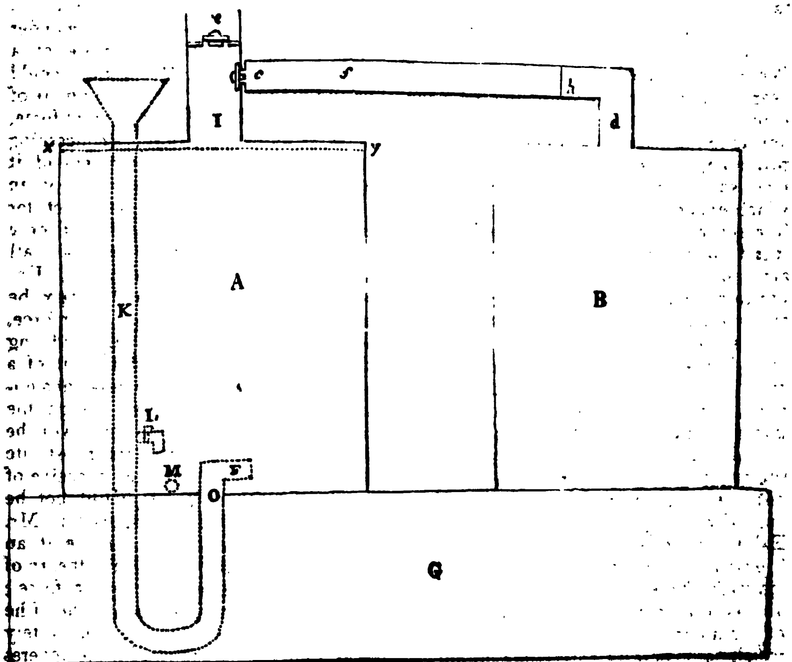
tion itself, for it must be as true of this property as of any other. We must not answer—of matter, for that would be to admit *the something* of which motion is a property. If we say that motion, extension, &c. are perceptions of the mind, then we admit they have no existence external to ourselves, and we enter upon another doctrine. We have, in the experience of our own minds, a conviction of the existence of something distinct and apart from our powers, and which preserves its own identity, amidst the fluctuations in extent and intensity to which those powers are liable. We are as confident as we can be of any thing, that we are not, as Hume would persuade us, a mere bundle of perceptions. We are conscious that sounds do not hear sounds, nor see colours, and that happiness is not percipient of misery, nor action of passion; but that a distinct principle, or being rather, is the common subject of these perceptions, and which exists in all vicissitudes the same in essence, whole and unimpaired. Now it is from these considerations, that we are led in an equally irresistible manner to conclude, that the powers which are external to us, are likewise connected with something distinct from themselves; that they are not a congeries of things, without a common bond to hold them in one identity; and that they are not the interchangeable properties of themselves, nor of each other—motion being neither the property of motion, nor of extension, nor of solidity, nor of any other quality, nor of an aggregate of qualities. Mr. Exley is, however, of opinion, that "power constitutes the very essence of matter." This if it be not *idealism*, is at least the doctrine of the *immaterialism* of the universe, according to the notion which is generally entertained of materiality. But if we admit the existence of a Deity, and that "power belongeth to Him alone;" and more especially, if we assert with Clarke, Dugald Stewart, and the most eminent moral philosophers, in the decisive language of a distinguished living divine—"that all events in the natural universe are the *immediate* effects of the Divine agency," and at the same time affirm that matter is mere power, we do unequivocally advance the doctrine of idealism, and become at once the disciples of Berkely, acknowledging with him the direct and immediate presence and action of the Divine Being, in accordance and in connexion only, with instituted and immutable laws. We make, in short, the sole cause in external nature to be that which is supreme.

On the supposition, that "power constitutes the very essence of matter," how strange must be our language, for instance, concerning attraction. We must say, that the power of attraction attracts another power of attraction. It is to me inconceivable that this force can have only a similar force for its object, without destroying all distinction between action and passion; or that it can have an object to act upon, without it has a subject to act from, and be reciprocally under similar influence, and therefore of a similar kind. If, as Mr. Exley would probably reply, we know nothing more of nature than of force acting against force, and make no further inference concerning it, we can only have a discernment of it *as force;* and herein certainly, that is, in our own minds, is found an object for force, but herein as certainly, it only finds an existence, and thus again all things are resolved into perception. Under this idea, force assuredly may be supposed to act against and modify force, both the operations and the agents being in the mind—like the working out of a geometrical truth by a mental demonstration—but as assuredly, though the truth may be as certain, they will be equally ideal, and we must substitute things for powers, or at least conceive of them in addition, if we would not be satisfied short of an external reality. Mr. Exley, however, does not make it an indispensable principle in his theory of physics, that matter is merely a force; but he allows the reader to imagine, if he chooses, the existence of indefinitely small solids at the centre of those spheres of attraction and repulsion which constitute his atom of matter. It is well known that Newton was of opinion that "God, in the beginning, formed matter in solid massy, hard, impenetrable particles;" and there is an expression of his, which, being unlimitedly advanced, shows that he could not even conceive of powers or properties in reference to matter, without something wherein they should subsist. He even asserts the same in reference to the Deity, and ventures to decide a question which ought to be unapproachable. With the confidence more characteristic of the metaphysician than

the philosopher, he says, that "God is omnipresent, not by means of his virtue alone, but also by his substance, for *virtue cannot subsist without substance.*" Though it be conceded that we may so determine concerning things created, are we warranted so to pronounce concerning the Creator? We give room for staggering inquiries regarding the nature of a substratum for omnipresent power. It is a mysterious subject, and is, and ever must be, wholly inscrutable to human reason. We ought rather, with a lowly mind, to say, that clouds and darkness rest upon it, and that it is for man to know where he ought to pause in his investigations. Who is entitled to judge in these matters?—"Where is the wise—where is the scribe?—Where is the disputer of this world?"

(*To be concluded in our next.*)

HYDRO-PNEUMATIC PUMP.



Sir,—I send you a sketch and description of an apparatus for procuring vacuum, which I have lately invented, and which I have called the hydro-pneumatic pump. Should you deem the communication worthy of notice, I shall feel obliged by your giving it insertion in one of your early Numbers; and have the honour to remain, Sir,

Your most obedient servant,

W. H. O.

Manchester.

Description.

The apparatus consists of two stout glass cylinders A and B; the one, A, may be termed the condenser; the other, B, the receiver: the former is fixed to the stand G, the latter is moveable, for the purpose of experiment. These cylinders are fitted with two upright brass necks I d; that of A is furnished with a valve e opening *upwards* into the atmosphere; and that of B is bent at a right angle, so as to screw at *h*, on the cross-branch *fe*

from the other neck, and thus to form with it an entire air-tight tube, which tube has a valve, *o*, opening *outwards*, by a spring or otherwise, into the neck I. The cylinder A is farther furnished with a tube K, for supplying it with water; it passes through the stand G, enters A at O, and terminates in F. This tube has a cock L, or other similar contrivance, for admitting or intercepting the fluid, as may be requisite; and near to this in A, as shown by the dotted circle M, is another cock for withdrawing the water from A, when necessary, each of these cocks being both air and water-tight.

The pump is put into operation in the following manner—the receiver B having been previously removed for the sake of experiment, by unscrewing its neck *d a b*, and afterwards replaced upon the standing, or rather upon a receiver-plate attached to it. First, the cock L being opened, and that at M shut, water is poured or admitted in any other manner into the pipe K, and flows from it into the cylinder A. As it rises it condenses the air within A; the valve *e* is consequently opened, and when it reaches the height indicated by the dotted line *x y*, it has expelled through *e* nearly all the air which the cylinder contained. The valve *e* having again fallen, the cock L is shut so as to cut off the supply of water to A. Now this cock, as well as that at M, being air-tight, and the former having, moreover, above it, a column of water, the level of which, by the laws of fluids, corresponds with the line *x y*, it necessarily follows, upon opening the cock at M, so as to allow the water in A to escape, and again shutting it (taking care, of course, not to admit any air from without to pass through it into A), that a vacuum will be left within A; consequently, the air in the receiver B will rush through the cross-tube *f*, and valve *o*, to restore the equilibrium, and will thus become rarefied; this effect will, indeed, take place as soon as the air in A assumes a less density than that in B. Further, as the air which A now contains, and which, it is almost superfluous to observe, possesses the same density with that in B, cannot pass back to B, for the valve *e* is now shut, it also follows, that, if the cock L be again opened and water readmitted to A, it will be, as before, condensed, and ultimately driven out at *e*; and, as a consequence, upon a second time opening and shutting the cock at M, another vacuum will be created in A; this will, likewise, be occupied by the air from B, which becomes, of course, still more rarefied; and these operations being repeated, the air in B will, at length, be so far exhausted, as to constitute an almost perfect vacuum.

I have not made any reference to the relative size of the cylinders, this being a point of but minor importance. I may, however, observe, it is advisable that A should be more capacious than B (in proportion, for instance, by diameter, of 1¼, or 1½ to 1); because, on the withdrawal of the water, the vacuum within A, and consequent rarefaction in B, will be the greater. On the other hand, it is evident, that, if A be made enormously large, it will not only require a considerable quantity of water for its supply, and a long period to fill; but the whole machine will, thereby, be rendered extremely unwieldy and inconvenient. It may, too, perhaps, be as well to state, that, in order to economise the water as much as possible, it may be conducted as it flows from the cock at M, by means of a pipe or otherwise, to a vessel appropriated for its reception, from which it may be again transferred to the cylinder A when required.

W. H. O.

MAP-PRINTING—MURRAY'S ENCYCLOPÆDIA OF GEOGRAPHY.

Sir,—It seems to have become quite the fashion of late years with authors and booksellers, whenever maps are required to illustrate their works, to go to the very extreme of shabbiness in getting them up. Even the west-end autocrat of the trade, "absolute John" himself, with all his aristocratic fastidiousness, does not blush to print the maps in Washington Irving's "Columbus," and other books of similar standard description, on a sort of blue tissue-paper, so wretchedly thin that the water-mark shows out with a distinctness vying with that of the engraved lines. Such miserable ultra-economy as this is quite inexcusable: we can put up with a black map, with the letters on a white ground, in the Penny "Guide to Knowledge," when we reflect that it is still, though

not so elegant, nearly as useful as a copper-plate in the usual style, and that it is the time and labour saved, by the reversal of the usual process, which enable the proprietors to let us have a map of London for a mere trifle. But what saving of any consequence can be effected by the substitution of a half-sheet of blotting-paper for one of a decent quality, in the getting-up of a handsome volume? Mr. Murray, and other delinquents on the same score, should "reform it altogether."

Among other frugal novelties in mapping, a new method has been introduced of composing a sort of letter-press map, with a very little assistance from the wood-engraver. This answers pretty well for plans of forts and harbours, &c., in such works as the "Penny Cyclopædia," for instance, where elegance of appearance is not of much consequence; but a complete failure is the consequence, whenever it is attempted to give a map of a large extent of country, or any thing else including a great number of objects and names, in this style; and in all cases it invariably has a very mean, paltry, and unhandsome effect. Yet, Mr. Editor, it is in this style that all the maps in Mr. Hugh Murray's lately-published "Encyclopædia of Geography" are executed—and miserable, indeed, is the effect produced. Surely, as this "Encyclopædia" was intended from the first to become a regular standard work, and to run through a "number without number" of editions, the proprietors might, without incurring the imputation of extravagance, have gone to the expense of having a decent set of maps engraved on steel or copper, instead of presenting the reader with a "complete atlas," which he soon finds to be worse than useless—an atlas in name, and in name only.

It would, indeed, be ridiculous to refer to any of these maps for the elucidation of the text. For one thing, owing to the manner of their getting-up, they present to the eye, at the first glance, a chaotic mass of lines and figures, without order or meaning, whilst a nearer inspection shows only an unaccountable medley of blunders and mistakes, of all sorts, sizes, and descriptions. And yet, with all this, the Preface leads us to expect the most scrupulous correctness; the Editor even calls particular attention to this branch of his work, and affirms that it has cost him considerable pains. "The maps," he observes, "which are so numerous as to form a complete atlas, have been executed from drawings by Hall, and having been *carefully revised by the Editor*, they will, it is hoped, be found to be *accurate*, and to include all the most recent discoveries." Let us see how this assertion is kept in countenance by the map of no more remote and inaccessible a portion of the globe than "The British Islands."

The attention is naturally at first drawn to the capital, and here a fine proof of the "careful revision" of the Editor stares the observer in the face at the first glance. "London" is duly placed on the north bank of the Thames, but bounded by two other rivers, one at the eastern, and the other at the western extremity: the former, of course, may be supposed to represent the Lea, but the latter exists only in the imagination of Mr. Hall, who drew on the Editor who "carefully revised" this most accurate of maps. After this, the omission of two such obscure places as Westminster and Southwark (and entirely omitted they are), may probably seem but a trifle; but it is certainly going too far to remove Plymouth to the Cornish side of the estuary of the Tamar, and thus place one of the most extensive of our seaports not only far out of its proper position, but even out of the county to which it belongs. "Chester" is almost as badly served; it is not placed out of Cheshire, but it is removed from the banks of the Dee to those of the Mersey, with as little ceremony as Plymouth is made to change sides.

It is quite evident from these two or three glaring instances alone, that this carefully-constructed map has been put together in the most careless manner; and a further inspection of it only serves the more fully to confirm that opinion. There is one circumstance, indeed, which operates strongly to shield its innumerable blunders from observation. The names of the towns, &c., are not given on the map itself, but in a separate page of letter-press, to which reference is made from the map by means of figures —a method which answers no purpose so completely as that of perplexing the reader, especially as the multiplicity of objects (the whole British Islands on an

octavo page!) adds to his confusion. This map is, therefore, any thing but an assistant in his studies, and must soon be looked upon only as an useless embellishment—very accurate (no doubt) in all its details; if it were not more trouble to puzzle them out than to do without the thing altogether. But the fact is, these details are shamefully erroneous. *Probatum est:* and here are a few of the results.

A great number of towns are placed on rivers with which they have in reality no connexion, and a still greater number are, with a sort of wilful perversity, placed on the wrong side of the rivers by which they are watered. Carlisle is laid down as close to the Solway Frith, although it is a considerable distance up the Eden; Bromyard, or, as it is erroneously called Bromford, is made to stand on the Teme, instead of the Frome, a river running in quite a different direction; Thetford is placed on the Waveney, instead of the Little Ouse, which flows in a course diametrically opposite, and which, although of equal importance to the Waveney, is omitted altogether; Manchester, on the Mersey, instead of the Irwell, which is only a tributary of the former; Woodstock, on the Charwell, instead of the Glyme; Chesterfield, on the Derwent, instead of the Rother; Bideford, on the Taw, instead of the Torridge, its rival, which is blotted out of existence entirely; Hertford, on the imaginary stream which washes the western extremity of London, instead of on the Lea, which flows into the Thames to the east of the metropolis; Cambridge, near the Ouse, opposite Huntingdon, instead of on the Cam, nearly twenty miles from that town; Alcester, on the Avon, instead of the Alne or Arrow; Monmouth, on the Uske, instead of the Monno and Wye, many miles further to the east.

As to Birmingham, although that midland metropolis is unprovided with any river at all, Mr. Murray has generously remedied the defect of nature, by making a fine stream run past it, and take its way southward to the river Avon! This is a bold stroke indeed, for, as it happens, the country about Birmingham is so disposed, that the small streams which rise near it, and even further to the south, all run to the northward, by means of the Tame (which, although one of our chief midland rivers, Mr. Murray omits), into the Trent, and the Trent into the Humber, which disembogues itself into the German Ocean, while the Avon flows through the Severn into the Bristol Channel, *on the opposite shore of England!* This grand imaginary river has another arm, also the fruit of pure invention, on which Tamworth is made to stand, instead of on the missing Tame; and these two streams are represented as the sources of the Avon, while its real source is left out altogether!

Instances of towns being placed on the opposite bank of their rivers to that on which they really stand, are so numerous, or rather innumerable, as almost to make it appear that pains had been taken to reverse their proper positions. Thus, Torrington is on the Cornish side of the Tamar, instead of on the Torridge, many miles into Devonshire; the city of Bath is removed to the south side of the Avon; Bedford to the south bank of the Ouse; Oxford considerably to the east of the Charwell, when it is actually close to its western bank; and Shrewsbury to the south bank of the Severn. Even the insignificant towns of Oundle and Thrapstone, on the river Nen, are, with great care and accuracy, seated each just opposite to where it ought to be. It is the same with Hungerford, which is made to flourish on the south side of the Kennet; with Preston, which is set down to the south of the Ribble; with Appleby, which is removed a good deal to the west of the Eden, from its old station close to its eastern bank; with Bellingham, in Northumberland, which is treated precisely in the same manner, with regard to the Tyne. In Wales, matters are as bad, or worse; the inland town of St. Asaph is placed on the sea; Towyn on the wrong side of its river; Tregarion ditto, ditto; while Llantrissent is watered by the Tawe, which does not come within several miles of the town!

Much needless confusion is caused by the manner in which the references are made to the letter-press, and this also has caused a plentiful crop of blunders. The number "139" is so placed that it is impossible to tell what town it is meant to refer to; it will serve either for Hereford (as it is intended to do), or for Tewkesbury; while No. "106" ap-

rivers either to Leominster or Hereford, so that the seeker for information would here be completely at fault. If omissions may be considered any drawback, Mr. Murray will have little to say for himself on that head, since, while he finds room for places so insignificant as Thedelthorpe, Billington (apparently a creation of his own), Coggeshall, Saltfleet, and a great number of the like importance, he makes no mention of the cities of Westminster, Rochester, and Winchester, and the great towns and ports of Whitehaven, Devonport, Bridgewater, Beverley, Reading, Wakefield, Huddersfield, Oldham, Bolton, Bury, Halifax, Sheerness, Gravesend, Chatham, and a host of others. In truth, the whole map is "full of omissions."

To make up in some degree for this, we have the town of Kendal twice over —once, as No. 13, in a spot where there happens to be no town at all; and again, as No. 30, pretty near its real situation, except that, of course, it is on the wrong side of the river. By way of another makeweight, too, the Welsh mountain Plynlimmon is actually transformed into an English town.

It will be seen that Mr. Murray has been particularly careful with respect to the rivers he has laid down; but full justice has not yet been done to all his merits on that score. These are ample. The river Wye is not considered as one of the principal rivers of either England or Wales —but the Dee is referred to under both heads, so that, being marked with the letter "m" in England, and the letter "c" in Wales, it adds considerably to the general confusion. In truth, bad as the matter is with the towns, with the rivers it is "confusion worse confounded." There is no letter of reference at all to the Thames, although the key appropriates to it the letter "j." The Don is pointed out by "g," but that letter is affixed both to the Don and the Derbyshire Derwent. The mark of the Tees is placed against the Trent, and that of the Trent against the Penk, an insignificant tributary. The courses of most of the rivers are incorrectly given; instead of the great Ouse being traced to its rise, its affluent, the Tow, is followed, so that Buckingham stands on no river at all; The Severn and the Wye are not continued upwards to within a great distance of their spring-heads; and many rivers of some consequence are entirely omitted. While the whole of the Yorkshire rivers have letters of reference appended, there are none whatever to their more southern rivals, the Mersey, Nen, Welland, Stour, Exe, Tamar, and others.

There are numberless minor errors, which might have been avoided by a little attention; such as placing "Uxbridge," not only where it ought to be, in Middlesex, but also some hundred miles off, in Somerset, where "Axbridge" ought to be; referring to *South* Barnstaple, instead of, as was perhaps intended, to Barnstaple (which has no prefix), and South Moulton, now omitted; printing Cotford for Coleford, Billingham for Bellingham, &c. &c. &c., none of which might have provoked attention, had not so great a noise been made about especial accuracy. There is another blunder of more consequence; both in the map itself, and in the accompanying key, Monmouthshire is made a Welsh county, instead of an English one! This is carrying the compensation principle a little too far: it might be only fair to award our Welsh neighbours *something* for the loss of their favourite Plynlimmon, but to make over a whole county for the purpose is really too bad; to say nothing of the unseemliness produced by the contradiction between the text and the map; the one insisting that England consists of forty counties, while the other allows no more than thirty-nine!

So much for this specimen of "careful revision." It would be a waste of time and space to go through Scotland and Ireland, in order to point out the errors in those parts of the map; suffice it to observe, that the whole of the mistakes and inaccuracies here recorded, with many more, are contained in a map occupying one-third of an octavo page, in a volume consisting of several hundred pages, which aims at becoming *the* standard repository of correct geographical information. "Ex uno disce omnes—" if such a number and variety of errors can be detected in a map of our own country, what must be the proportion in those of countries not so intimately known?

The two or three pages of text which follow the map, relating chiefly to the courses of the rivers of England, also display a marvellous ignorance of the subject. The writer makes sad havoc

even with the Thames. After describing its rise, with very few mistakes, he goes on to say, "Near the classic haunts of Oxford, it receives the Charwell *and the Isis*, assuming, on its junction with the latter, the compound name of Tamesis, which has been abbreviated into Thames." Why, the very river whose course he has been describing *is* the Isis—the Thames being called indifferently by either name until its junction with the *Thame*, some miles *below* Oxford, after which it is always called "the Thames." After this it seems scarcely worth while to notice how jauntily this pink of correctness talks of its "winding *northward* through the wooded vale of Maidenhead"—where, unfortunately for him, it flows directly south!

He is still more at fault in Yorkshire. "The Ouse," he observes, "formed originally by the confluences of the Aire and the Swale, from *the uplands of the North Riding*, is *subsequently* augmented by the Wharfe." This is rich indeed! Unless matters are greatly altered in Yorkshire, the Aire has so little to do with "the uplands of the North Riding," that it does not go near the North Riding at all; and, moreover, it does not join the Ouse until long and long after that river has been augmented by the Wharfe! We are further informed, that "the Ouse, with its branches, forms one of the most useful and least beautiful of English rivers. It winds a sluggish course through manufacturing districts and rich arable fields, without any diversity of scenery." This is even a richer "bit" than the former. The branches of the Ouse are renowned as being among "the most beautiful of English rivers," and especially so for that "diversity of their scenery" which the "Encyclopædia of Geography" so coolly denies them. The description, in most of its particulars, would apply pretty accurately to the Ouse of the midland counties; but it is sadly out of place where it stands. Who has not heard of the picturesque beauties of the banks of the Wharfe and the Swale? Yet these are included in the sweeping condemnation passed on the branches of the Ouse; they are even mentioned by name in a preceding paragraph, in order, as it should seem, that there might be "no mistake" as to the scrupulous correctness of the information!

So much for England and Wales. How the other countries of the world escape it is no easy matter to tell, for the labour of pointing out all the errors in a work, where they are apparently so "thick and threefold," as in this, would evidently exceed that of compiling the work itself. A passing glance at the map of Australia is, however, tolerably satisfactory on the point, particularly as the Editor, in his Preface, draws more than common attention to the excellence of his information as to that colony, on the ground that he has been favoured with the assistance of Mr. Baron Field, many years a resident at Sydney, in the preparation of that part of his undertaking. This assistance has, certainly, enabled him to present many striking novelties in his map: such as placing Sydney (the capital) on the north shore of Botany Bay, when common geographers would have followed all previous authorities, by seating it on the south shore of Port Jackson; making the rivers Lachlan and Macquarie (which stupid colonial surveyors-general, who have been sent to explore them, report as losing themselves in immense marshes in the interior), flow, as they ought to do, towards, instead of away from the colony, and so "right on end" into Botany Bay; thus affording to the Australian metropolis that great advantage, a convenient means of water-conveyance to all parts of the interior. Besides these flights, there are several others not, perhaps, quite so laudable; the Hawkesbury, the principal river of the colony, and Broken Bay, into which it falls, are both dried up without compunction; while Paramatta and Newcastle, which *were* two towns of some consideration, are razed to the ground, "and not a relic seen." Yet, to make up for this, Richmond enjoys the navigation, not, as some make it, of the puny Hawkesbury, but of the majestic Macquarie, which flows up hill, over every impediment, in order to achieve the useful purpose; the Castlereagh, also, is equally accommodating in that particular. After this, not a word more need be said to prove that these maps have been so "carefully revised," that they include (at least) *all the most recent discoveries.*"

I remain, Sir,

F. H.

London, April 9, 1835.

FRESHENING SALT-WATER BY REFRIGERATION.

Sir,—The freshening of sea-water, and rendering it pure and palatable, seems as far as ever from being brought into practical use in the navy, notwithstanding the operations of the "Royal Salt-water Purifying Company," and of their opponents, Messrs. Fraser and Baker. As the subject seems to be one of some nautical importance, I send you the substance of an article containing a description of a method of effecting the desired end in an altogether different manner, discovered by a M. C. F. Saltzer, which appeared in the "Recueil Industriel" for Feb. 1833. I merely give you the substance of the article, for, as is the case with all French writers, the matter of fact is adorned (or otherwise) with more verbiage than could be found room for amongst the condensed information contained in the Mechanics' Magazine.

After descanting upon the difficulty and importance of the subject, and the learned chemists who have turned their attention to it, M. Saltzer mentions the well-known Essay of Dr. Lind, published in London in 1774, which described a method then partially adopted in the English navy. This process consisted in distilling the sea-water with the least possible heat, and removing atmospheric pressure; but the water produced was, according to M. Saltzer, found impregnated with muriate of magnesia, iodine, bromine, and other foreign substances, and had not the fresh taste of spring-water. M. Saltzer states, that having been informed the English Government attached great importance to the discovery of a more efficient process, he particularly turned his attention to the subject; but after duly considering the various methods in which it had been proposed to get rid of the salt by distillation and filtration, he renounced them all as too troublesome and complicated to be carried on in a ship at sea. Chance, he continues, at last came to his succour:—one morning, in winter, he found pieces of ice formed in some saline solutions,—tasting the crystals, he found them perfectly sweet. "Thus," he exclaims, "the greatest difficulty I had to vanquish was surmounted." That this, however, was the greatest difficulty, may be doubted. The next step appears to me to be by far the greatest, namely, to discover the means of producing ice from sea-water in sufficiently large quantities. M. Saltzer's process, he describes as follows:—"I procured a good pneumatic apparatus; I then placed under the receiver a saucer full of sulphuric acid, or muriate of lime, fresh and well pounded; over this I placed another vessel with sea-water; I made a vacuum under the receiver, and on the ascent of the barometer one-half line, the sea-water was changed to crystals." These crystals he pounded, and placed in a funnel to allow any salt-water that might be adhering, to drain off; he also washed them with a little fresh water; and then melting the ice, he found a very pure, drinkable water.

M. Saltzer naturally supposes that it will be asked, whether this method can be put in practice to produce sufficient ice for the crew of a ship? He answers, that as far as regards the making of ice, it is produced artificially in a great part of America for the confectioners; and that, since a small quantity can be obtained, it is not more difficult to make as much as you please!

But, judging from the observations of Professor Hare, in his description of an ice-making apparatus, extracted from the Journal of the College of Pharmacy, Philadelphia, into the 584th Number of your Magazine, I should imagine that M. Saltzer must be misinformed as to the practice in America. "The congelation of water," says Professor Hare, "by its own vaporisation, accelerated by exposure to the absorbing power of sulphuric acid, or other agents in vacuo, has always been a difficult experiment." The learned professor then complains of having failed to produce ice by this means before his class. An excellent pump, with perfectly air-tight cocks, and in good order, he declares to be indispensable. And the main object of his invention is to render the pistons, valves, cocks, and other openings, perfectly air-tight. Now, if so much difficulty attends an experiment on a small scale, for the mere object of illustration, what are we to say to the feasibility of a plan for making it an every-day process on board ship, on a large scale?

Leaving the whole matter in the hands of those who may think it worthy their investigation,

I remain, &c.,

S. M.

April 6, 1834.

In February last, Mr. Blanch, a gun-maker, of Hull, applied for a Patent for an apparatus for saving the lives of shipwrecked mariners. The application was opposed on the part of Mr. John Murray, the eminent philosophical lecturer, who had reason to suppose that the apparatus, which Mr. Blanch was seeking to appropriate to himself, was no other than Mr. Murray's well-known gun and arrow, invented as far back as 1819, and described in our 16th vol., p. 289. Mr. Blanch had, it appears, several months ago, received an order from Mr. Murray to manufacture a gun of a more perfectly cylindrical bore and greater length, than any he had hitherto used; as also to make some corresponding modification of the arrow. "After supplying him," says Mr. Murray, "with arrows and lines, and the pamphlets I had written on the subject, I desired him to make a few experiments, *at my expense, of course*, to prove the gun; and on the 31st of Dec., he wrote to me, stating, that he had done so—that the experiments were satisfactory, *and duly waited my further orders.*" Shortly afterwards, however, Mr. Murray saw it reported in the newspapers, that this very Mr. Blanch had himself invented a life-preserving gun, for which he was about to solicit the public patronage; his suspicions were naturally roused; and that there might be *no mistake*, he prudently entered a *caveat* at the public offices, against the grant of any patent that might interfere with his own invention. Eight days later, Mr. Blanch did actually make his application for a patent; and on the 10th of March last, the question of granting it, came on for determination before the Attorney-General, Sir Frederick Pollock, when, on receiving from Mr. Blanch and Mr. Murray a disclosure of their respective pretensions (separately and confidentially, as the practice is), Sir Frederick reported to his Majesty against the grant of the patent.

NOTES AND NOTICES.

A Joint-Stock Company has just been set on foot for establishing a steam communication with India by the old, and, as some maintain, the preferable route of the Cape of Good Hope. This, it will be recollected, is the project so strenuously recommended by the Messrs. Seaward.

Euphrates Expedition.—Letters from Malta, dated March 13, mention the safe arrival of the George Canning at that island with the officers and stores of the expedition. The whole party were in excellent health, and intended to sail for the Orontes on the 7th ult.

Preparations are making at Brussels for opening the railroad from that city to Malines on May 1. This is the first part of the line which is to run from Antwerp to the Prussian frontier. It is said that there are to be three steam-carriages differently laden. The first, which is called La Fleche, will contain the engineers and other persons who have been engaged in forming the road, and will perform the distance in 17 minutes. This will be followed by the Stephenson, impelling waggons filled with the Ministers, Deputations from the Senate and Chamber of Representatives, and other Officers of State; and in which will also be seated Mr. Stephenson, the English engineer, under whose management the railway has been formed. The third convoy of waggons will contain several hundreds of persons, drawn by an engine called the Elephant.—*Morning Herald.*

Candles.—A new substance has been discovered by M. Lecanu, by exposing tallow to five or six times its weight of boiling ether, or turpentine, which completely dissolves it, and which, in evaporating, deposits stearine, a substance which is as inodorous, but does not burn so quickly, as spermaceti.—*Athenæum.*

Calculating Machine—Another Rival to Mr. Babbage.—Sir, Having seen some notices in the public papers of calculating machines invented at home and abroad, I think it right to state that I have myself invented one, which is exceedingly simple, and might be made at the same expense as a common clock or time-piece. I can find the 10 power of the 9 digits in about twenty minutes; in fact, Addition, Subtraction, Multiplication, Division, the Rule of Three, Involution, Evolution, and a few other rules, may be worked with despatch and facility. The parts of my machine do not require such a critical adaptation, nor are they so liable to get out of order, as those of Mr. Babbage's machine; they may be made by any ingenious mechanic, and worked by any wayfaring man, though a fool. I remain, Sir, your humble servant, J. S. HOLLAND—*Three Colt-street, Limehouse.*

S. T. cannot take out a patent in France after having specified in England.

Communications received from Mr. Matthews—A Constant Reader (Newcastle)—A. H.—Mr. Sutton—M. D. E.—A Sailor—Mr. Durand—R. G.—A Railway Traveller.

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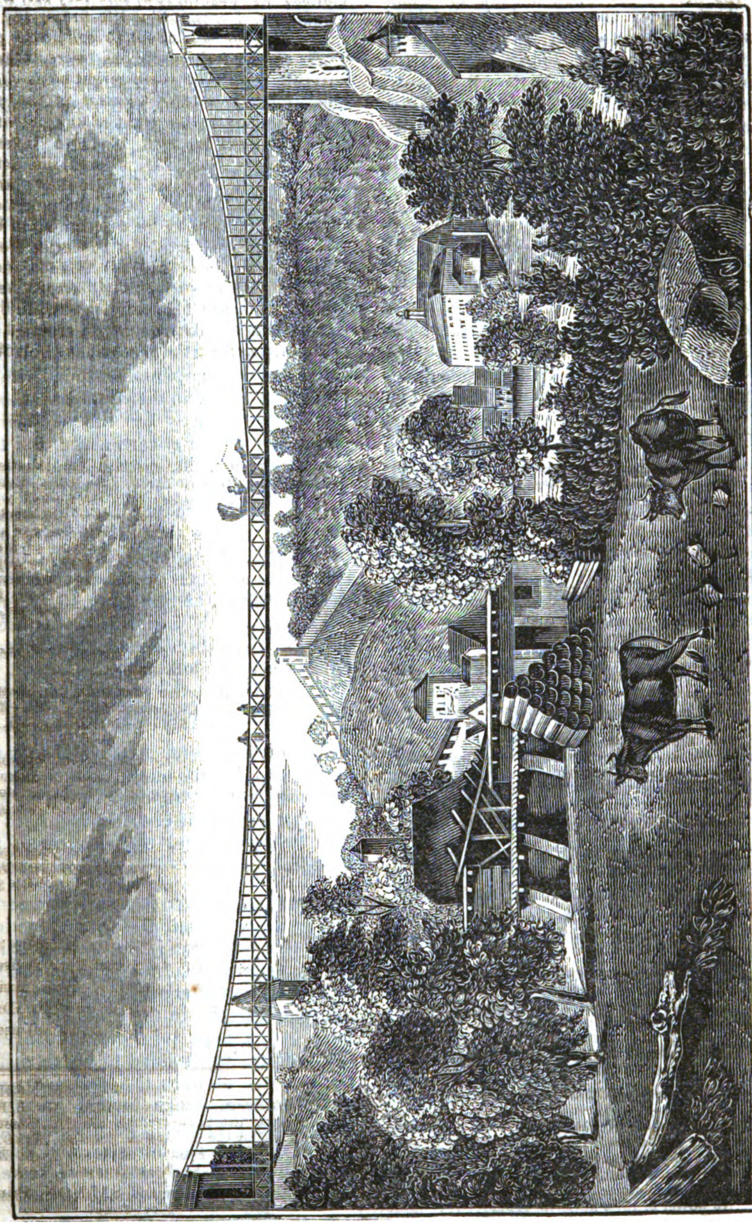

FREYBURG SUSPENSION-BRIDGE.

DESCRIPTION OF THE FREYBURG SUSPENSION BRIDGE.

(Translated for the Mechanics' Magazine, from the German. By Mr. J. E. Terry, C. E.)

The city of Freyburg, in Switzerland, is well known to most travellers for its remarkable locality, being seated partly in a deep and winding valley, watered by the river Saone, and partly on the adjacent high and overhanging cliffs. To arrive at the centre of the town, by the road from Berne, carriages were formerly obliged to descend the steep declivity of the Staalberg. On arriving at Bernegate, it seemed to travellers as if they had already got to the end of their journey, but great was their astonishment to be informed that they had yet to travel for half an hour before they could reach the city—to follow the several large windings of the river, cross it three times, then to ascend the long, difficult, and steep ascent called *Alt Brunnen Strasse* (Old Well-street), which was at all times enough of itself to dismay a traveller, and has proved the death of many a horse. The bad state of the roads, and defective plan of the streets leading to the centre of the city, increased the difficulty of approaching it. Industry, commerce, social life, all felt alike the influence of this almost isolated position of the place. But what could be done? The obstacles seemed insurmountable; the almost perpendicular cliffs on which the chief part of the town stands, seemed to mock the idea of forming a street through them of any tolerable degree of ascent; and had even this been possible, it would only have tended to increase the length of the windings. On the other hand, the idea of erecting a bridge, either of wood or stone, of a sufficient height to overcome the difficulty of the rugged ascents and descents, seemed too daring for contemplation, the height being upwards of 150 feet, and the length much greater. The expense, too, especially if stone had been employed, would have been out of all proportion to the means of the citizens; for the city is not rich, being but little frequented, and thinly populated, containing, exclusive of the suburbs, no more than 9,000 inhabitants.

Some of the more public-spirited and zealous citizens, who had heard of the iron suspension-bridges erected in other countries, at length proposed to raise, by subscription, the pecuniary means necessary for ascertaining the applicability of such a structure to the natural circumstances of Freyburg, and if practicable, of actually constructing it.

As soon as the subscription reached a suitable amount, several eminent engineers were consulted, and after examination of the plans of different competitors, M. Chaley, the famous French engineer, who erected the wire-bridges at *Beaucaire*, *Chasey*, and several other places in the south of France, obtained the preference. The contract agreed on with him on the 10th of Feb., 1830, was to this effect:—that he was to have, at different instalments, 200,000 (Swiss) francs, for the completion of an iron wire-bridge; that the expense of the approaches on both sides, and the compensation to individuals for loss sustained in their property, should be defrayed partly by the subscribers and partly by the government; and that the contractor, M. Chaley, subject to certain conditions, should have the enjoyment of the produce from the tolls for 80 years. Some time afterwards, these conditions were considerably modified; it being agreed that M. Chaley's right to the tolls should be limited to 40 years, at the end of which time, the profits are to revert to the subscribers during 59 years, after which the toll is to cease, and the bridge to become the property of the canton, or common property.

The first general meeting of the subscribers took place on the 19th of March, 1830, when they appointed a committee of 10 members (afterwards increased to 20) to superintend the erection of the bridge.

Immediately after these arrangements, the necessary preliminary preparations were entered upon; but the political disturbances which broke out, in 1830-1, in France, and afterwards in Switzerland, but particularly in the canton of Freyburg, had a most injurious influence on the undertaking—added to which, differences arose between the contractor and the committee, which tended greatly to retard the project. The general good will of the citizens, however, and the indefatigable zeal and activity of some of the leading members of the committee,

recalled ere long the dormant project into life and activity. In March, 1832. the works were entered upon with great zeal, and the first stone of one of the porticos was laid under the superintendence of the architects *Kraser* and *Brugger*. From that time the works were continued in every department without interruption; and, to facilitate their progress, a temporary bridge was thrown over the river Saone, it being for the ease and advantage of the workmen to get from one side to the other without loss of time.

The finances of the company were all expended, however, long before the bridge approached to its completion. But though the funds were exhausted, the ardour and generous feeling of the subscribers and donors were not. Government, which, from the beginning, had given its particular sanction and protection to the measure, came once more to its assistance, by granting leave for the opening of a lottery, which produced to the company the sum of 80,000 francs.

The work was now once more renewed with vigour, and on the 9th of June, 1834, the subscribers had the gratification of seeing extended across the valley, the first of the numerous wires which form the two main ropes or supports of the bridge. Next followed the fixing of the subordinate suspension wires, and the laying down of the beams to form the foundation or flooring of the bridge. The latter mentioned operation took place, it might be said, in a magical manner. The inhabitants were not a little surprised to find at their gates an unlooked-for, and for foot passengers, a sufficiently solid bridge, where, ten days before, they had seen only two immense wire-ropes. After this, the other various inferior works soon followed, as the completion of the footway, the erection of the balustrade, &c. At length, on the 8th of Oct., a carriage was driven over the bridge at full gallop, which was followed, on the same day, by the stage, or post-coach, from Berne to Freyburg, enthusiastically greeted by a vast number of astonished spectators.

The balustrades, though simply modelled, present, nevertheless, a very handsome appearance. Any vehicle, be it ever so heavily laden, may safely venture over; and although the ear is at first rather startled at the noise of the trampling of horses, yet the most clear-sighted person cannot discover the slightest motion communicated either to the wire-ropes or to any other part of the bridge. The traveller passing over does not feel the least vibration, and his astonishment finds no bounds, to think that he has arrived so soon, and in safety, across the deep gulf below.

As has been before observed, the whole structure is suspended by two large *ropes of wire*, firmly secured at each end, by being let into shafts made for that purpose. At each end the porticos, over which the ropes pass, serve for *antagonist supporters*, or counterforts. They are built partly of limestone, brought from Neuenberg and Neuenstadt, and partly of sand-stone which is got in the stone quarries in the neighbourhood of Freyburg: all the blocks are, by way of greater security, connected with each other by means of iron cramps. The quantity of iron used for this purpose was 570 cwt. The height of the porticos is 65 Berne feet. The opening for the gateway is 45 feet high, 20 feet wide, and 19 feet in depth; the width of each pillar is 14 feet. About 160 feet from the porticos the shafts are situated; their depths are each 58 feet, and their diameters 32 feet. These shafts are hewn out of the rock on both sides, and comprise each three chambers, situated at a certain distance from each other, each containing three immense unwrought blocks of Neuenberg stone, to which the *main wire ropes* are fastened. The connecting wires or chains, 16 in number, are drawn through these vaults; they rest at the same time on 12 cast-iron cylinders, and are held fast by 128 anchors or grapples, of a total weight of 1,024 lbs. These connecting ropes or ties serve the great main wire ropes as auxiliary supports, which bear up on both sides the great beams of the bridge-flooring, by means of suspension wires or ties. The length of the main wire ropes is 1,280 feet each. They consist each of 2,000 separate wire threads, which united make a mass of 4,000 threads, or little chains, of a total weight of 960 cwt. Dependent from each of the two main connecting wire-ropes, or inverted arch, hang 164 smaller suspension wire-ropes, at about 5 feet asunder; these are made fast above through iron

loops, and below are connected with hoops of iron, into which the beam-ends which support the footway are firmly fastened. The longest of the smaller dependent ropes of wire is 60 feet, and the shortest half a foot; each is composed of 25 single wires, so that the roadway of the bridge is held up by more than 8,000 single wires. The number of beams which form the foundation or platform of the bridge, amounts to 166, held together by 328 hoops of wrought iron. Four lines of beams run longitudinally throughout the whole length of the bridge, upon which rest the two footways. On both sides, to separate the carriage-way from the footpaths, are strong oaken balustrades, made in the form of St. Andrew's cross, the height of which is four feet. The carriage-way is 16 feet, and each foot-way 3 feet, wide: so that the total width of the bridge is 22 feet. Its total length, including the two counterforts, over which the main wire-ropes are passed, is 941 feet; exclusive of the counterforts, its length is 903 feet; the carriage-way alone is 864 feet. Its height above the river, when measured 30th Oct. 1834, was 163 feet.

The quantity of iron used in this work was not less than 80 tons, and of wood 135 tons.

The weight sustained by the two main wire stays is 120 tons; and it is calculated to sustain the amazing and enormous weight of 2,400 tons.

J. E. T.

GRAND NORTHERN RAILWAY.

A company has been formed, or rather is proposed to be formed, for the purpose of constructing a railroad from London to York. From the prospectus and map, which we have received, it appears, that the line is to commence at Whitechapel, and to pass through Dunmow to Cambridge, and thence through Lincoln, by way of Selby to York. Branches are proposed to be made to Norwich (a great feature of the plan), and proprobably to Nottingham and Sheffield. The prospectus further contemplates a continuation of the line from York to Carlisle, and thence into Scotland; and even, in consequence of the short distance across the Irish channel, from Portpatrick to Donaghadee, the trade of Ireland is also calculated on in the scheme. The capital is to be 3,500,000*l.* To this series of undertakings, there appears to us to be this objection, that almost all the great districts and towns proposed to be visited upon the route may be reached by a shorter distance, from the line already in progress of completion from London to Birmingham, Manchester, and Liverpool, &c. Thus, a series of manufacturing towns, commencing at Leeds, and including Sheffield, Nottingham, Leicester, and Northampton, may all be connected with London, by a railway from Leeds to the Birmingham railway, below Northampton, by a saving of distance of above twenty miles. Then, also, the lines proposed from Scotland, may be very obviously brought through Carlisle to Manchester, Birmingham, and London, by a nearer route than by York. Divested then of the advantages of the trade of the great manufacturing districts, there is not the smallest probability that the mere trade of the agricultural counties, through which the Northern Railway is to pass, would be sufficient to authorise the investment of the enormous sum required for its construction and support. Railways, it is now seen, can only be constructed to advantage, through districts of extensive trade and dense population. The branch to Norwich, proposed in this scheme, does not materially redeem it from the charge of too great poverty of line; and as this branch-road would only benefit by the Northern Railroad, so far as Dunmow, not one-third of the distance between London and Norwich, the cost and profit arising from it may fairly be put aside in the general question. It seems then to us, that this scheme is not a well-founded one; and as the Birmingham Railway will include, with its branches, all the main districts, upon which the traffic of the York line is proposed to be built, we think it our duty to present these considerations to the public. So immense is the cost of constructing and repairing a railroad, that some engineers entertain considerable doubts whether even the Birmingham and London Railway, with all its vast probable confluence of trade, will prove to be so profitable a speculation as is usually supposed. It is to be desired, that the whole system of railway-transit, which, if judiciously introduced, will confer such boundless advantages upon this country, should not be brought into disrepute as unprofitable, by the failure of undertakings, for which there never was any rational hope of success; and believing, as we do, there are already several such doubtful lines in the act of formation, we are the more anxious upon the subject, and recommend all speculators to examine well the map of England, before they embark in so large an undertaking as this great Northern Railway represents itself to be.—*Athenæum.*

ON MR. EXLEY'S NEW THEORY OF PHYSICS.

BY BENJAMIN CHEVERTON, ESQ.

(*Concluded from our last Number*, p. 41.)

We have now taken a review of these indefensible doctrines, and it has been shown that we can neither conceive of substance without power, nor of power without substance—understanding in the first case essential power, and in the second, finite power—for in both cases, our utmost conceptions resolve themselves into, and are identified with, the the idea of God's direct and immediate action on intelligent natures, or else we are led into consequences which cannot be contemplated, or driven for refuge into what is inconceivable or absurd. It would appear, then, that power must either dwell with its fountain source, or there must exist something to which it attaches, or which is endowed with it. To the one or the other of these doctrines we must resort, for there does not appear to be any tenable ground on which we can rest a middle opinion. They are based on broad and clearly defined views of God's procedure; they are not obscured in ambiguity and feebleness of conception, nor separated from dangerous errors by subtle and shadowy distinctions. We can form a clear and distinct conception of matter being in possession of power which is essentially *its own*, not, however, in virtue of a necessity of its nature, but in virtue of the will of God, and which is as necessary for its conservation as it was for its original existence—we may, I say, clearly conceive of matter as being thus constituted a subordinate agent, and we can also form another very different, but still a clear and distinct conception of the Almighty power alone, standing amidst the intelligent and percipient beings which have proceeded from him, of the entire absence of intermediate agencies, and of the immediate presence to our apprehension of one sole and universal cause. There does not appear to be any alternative beyond these two opinions, and, therefore, (if any) the one or the other ought to be entertained. The reader must determine for himself which is most worthy of acceptance. It is not for me, it is not for any man to dogmatize herein. Hesitancy best becomes us on such subjects, and a deep conviction of our ignorance, and of our total inability to pronounce confidently, is the better part of wisdom. A few words on each doctrine must suffice.

1. It is difficult to imagine why philosophers and divines should manifest such repugnance to the assignment of efficient or essential power to matter. This doctrine does not affirm that such power is independent of the Deity, neither in its origin nor in its continuance, but ascribes all power ultimately to HIM. It only contends that it is as separate and distinct from the Divine Power, as the substance which supports it, is separate and distinct from the Deity; and that it has equally with the substance a real existence, and is as equally the work of God's infinite power and wisdom. But these persons are not satisfied with such a statement. This doctrine, they say, "acknowledges, indeed, God to be the Creator, and also the *Upholder and Conservator* of all things; but still its theory is but a Christianised-paganism. It throws back the first and *only efficient* cause to an unmeasurable distance; weakens or denies the doctrine of his *immediate agency*; and, in fact, puts God 'far from us.' If there be a chain of causes and effects, he not only sustains it, but lives and acts along its whole line; and thus may we 'foresee him always before us,' 'all in all,' and all in every thing." Again, a recent very eminent writer and philosopher observes—"the knowledge and the agency of the Divine Being pervade every portion of the universe, producing all action and passion, all permanence and change. The laws of nature are the laws which He, in his wisdom, prescribes to his own acts; his universal presence is the necessary condition of any course of events; his universal agency the only origin of any efficient force." Thus, every thing, according to these philosophers, is, in so especial a manner, full of God, that they need have no dispute with Berkeley. As nature consists so entirely of the acts of the Deity, what is there to sustain or uphold but his own doings? The existence, or non-existence, of so effete a substance, as matter is supposed to be, is not worth contention. It is not discerned by us, it is not perceptible to us; for God is "all in all"—"producing all action and passion, all permanence and change." Not content with the admission, which, of course, is cheerfully

made, that the being and well-being of all things depend on his Will, they rob nature of every power, in order to magnify his greatness, and impress upon us more sensibly our entire dependence on Him. It is impossible, however, that that admission can be exceeded by any statement whatever, in producing a more forcible impression of our dependance, for it is already granted to the utmost conceivable extent; and as to his greatness, surely it is not less to exalt his attributes, to ascribe to him the power of conferring on the works of his hands a certain extent and degree of power, whereby his will and intentions may be wrought out by a delegated subordinate agency, as it is to imagine, that they can only be fulfilled by his having recourse to his own energy, and by making all the effects and events of nature to be his own act and deed. It will be conceded to these writers, that it is not easy to conceive of a power of real efficiency being possessed by matter, without making its existence to arise from an eternal necessity of its own nature; and that it is equally difficult to conceive of a power being imparted to matter, without tracing in its conveyance the identity of its nature with that of its fountain source, and thus, (carrying in idea the Giver along with the gift,) seeing his agency alone in all effects resulting from this cause. I would, however, observe, that if this difficulty be an objection, it derives all its force as such from our own ignorance, or rather from the limitation of our faculties. It is augmented, perhaps, by the imperfection of language, which, on such a subject, is really metaphorical, and is therefore calculated to mislead. We must not under such influence conceive of power as an entity separate from its subject, which can be transferred from one being to another—for to contend that natural power can only arise from a transference of the Divine efficiency, is to parcel out the Godhead, and to deify matter; but we must raise our thoughts to the contemplation of matter as starting forth into existence at the will of its Creator, in the simultaneous possession of power as a condition necessary to its essence, or, in other words, as being created and endowed in the same act with power as an integral part of its very existence, and as absolutely its own as though it claimed an independent being. This view gives us a sublime conception of the Divine Omnipotence, and is not more incomprehensible than the act of creation in any sense. Who shall say that power cannot *begin?*—and who can say it, and not say the same of that which supports it? Both are alike beyond our comprehension; and our ignorance is no qualification by which we may affirm that their coetaneous, coessential existence cannot be. But how are we qualified to affirm that it *may* be? The profoundest metaphysical reasoning, the utmost stretch of mere intellect, will not reach to the height of this exalted theme. We can only take cognizance of facts, and reason from analogy. We take knowledge, then, of the possibility of power standing by itself, that is, separate and distinct from the Divine Power, in our consciousness, that such is the fact in our own case. We have an instance in ourselves, of the calling forth of power into existence by an act as truly creative as the existence of substance can be referred to, for "it is He that hath made us, and not we ourselves." We know that such power is a real efficient power, and so truly our own, that the Deity cannot and must not be implicated in any of our actions. We are too conscious in the feeling of our own impotency and unworthiness, that we are not "a spark" of the Divine power and intelligence in any other than a poetical sense. And yet, on the other hand, we are sensible that we do not possess an independent existence, that neither our being nor our continuance in being is of ourselves, and that we are dependent on a power superior to our own. Such is the mysterious relation in which we stand to our Creator. We proceed from him not strictly as an effect flows from its cause, but as the creatures of his absolute Will, and thus, though upheld by a continual act of his Will, we are in possession of power as absolutely our own, and as of equally efficient causality, within the limits assigned to us, as though we claimed an independent being. We see, therefore, the possibility of power existing as an essential part of created natures, and consequently, as separate and distinct from the Supreme power; and we are hereby led to conceive how power of a lower order, blind, unintelligent, and instinctive, may be

assigned to matter, or made rather to form an essential part of its existence, without confounding it with the power of the Deity. Our own consciousness convinces us of an *originated* power, and of its having the character of a real ultimate efficiency, and yet without its existence arising from a necessity of its own nature, or of the being which claims it; and we are hereby led to conceive, how power of a lower order may have had a beginning, along with, and as a part of, material nature, and how there may be constituted a real, efficient, and ultimate causality—nothing being ulterior thereto but the Divine Will—and yet, without ascribing to matter a self-existent, Eternal being. The high *à priori* course of reasoning is utterly worthless on this subject, as in many others. We can only take analogy and our own experience for our guides, and these convince us that the above conclusions regarding matter are at least probable. A philosopher of high eminence, absent at present from this country, says, "The Divine Author of the universe, by creating his materials *endowed* with certain *fixed qualities and powers*, has impressed them in their origin with the *spirit*, not the letter of his law, and made all their subsequent combinations and relations inevitable consequences of this first impression." The other eminent writer already referred to, and quoted in this paragraph, cites this passage in corroboration of *his* views; but, if I understand it aright, the sentiments it conveys are quite in accordance with the doctrine of the efficient causality of matter. The author himself appears to have been aware that he had unequivocally advanced this doctrine, for, fearful that from an unqualified statement the wrong inference mad be drawn, that matter was thus releasey from all further dependence on the Divine Being for support, he immediately subjoins the following,—"by which, however, we would no way be understood to deny the constant exercise of his direct power in maintaining the system of nature, or the ultimate emanation of every energy which material agents exert, from his immediate *will*, acting in conformity with his own laws."

2. Another class of philosophers, however, denies the existence of matter, and conceives they can explain all appearances by a more simple hypothesis, and which has already been incidentally and sufficiently explained. It must not be imagined this doctrine teaches what has been constantly imputed to it by those who do not understand it, that we are always under an illusion in regard to the objects of sense. Our perceptions are of course real, and the impression that they result from external causes is equally real, and this scheme does not deny that it is true also, or that such causes do really exist. The subject in dispute is merely a metaphysical point regarding the nature of those causes, whether they appertain to a subordinate agency or to the immediate agency of the Deity; and the difference on the part of those who make use of the latter terms, and yet inconsistently contend for the existence of matter, is, as we have already seen, of the most subtle and sophistical kind, and unimportant wherewithal. All the phenomena of the universe, as being the manifestations of power in varied forms, developed and regulated in obedience to laws characterised by wisdom, goodness, and immutability, are equally real to us and true in themselves, whether the power be secondary or supreme, and whatever be the nature of the substratum which upholds it—created or uncreated. Whichever it may be, the power is that alone of which we are cognizant, and it carries along with it all possible evidence of its truth and reality in its very manifestation. Doubt and delusion have room only in the fallible inferences therefrom of man's presumptuous and insufficient reason. No question can arise as to the matters of fact; but metaphysical reasoning, concerning the essence of their causes, may be very questionable. Berkeley's doctrine may be wrong, but it is by no means ridiculous, except in the opinion of the sciolist; and many men of strong minds have been found to embrace it. It certainly *cuts* the knot of many difficulties on the subject of infinites, but we must enter on a new state of existence, ere we can determine what is the truth concerning it—whether this or the other doctrine, which has been placed under your readers' notice, is most worthy their acceptance.

We have thus seen that, though Mr. Exley has advanced his peculiar doctrine, apparently without sufficiently examining it on all sides, and adverting to all

its consequences, he is by no means singular among our divines and philosophers in stating opinions, or at least in making use of unguarded language, which they should either renounce or correct, or be prepared to take up with idealism on the one hand, or pantheism on the other. It is curious to observe that both these wide and opposite extremes are of oriental growth, and were promulgated in the early ages of mankind; and it is humiliating, but useful, to remark, that knowledge on this subject has not advanced a single step. They are led into these devious ways, through a laudable desire to maintain a strong impression in our minds of the presence of the Divine Being, and to prevent us, in our feeble efforts to look through nature, from losing sight of nature's God; but, unfortunately, they overstate the argument; and, by denying that matter can be otherwise than inert, they make the Deity to be its vivifying spirit. If abhorring this gross pantheistic notion, which was very naturally and consistently the parent of idolatry, they still contend that the powers of nature exist as an immediate emanation of Divine power, they are driven to the only remaining alternative of believing that those powers constitute the only external existences, having their subsistence in the Divine essence, and that thus we see every thing in God. Newton was very cautious in his language; and, further, to guard against all misconception, he did not deem it unnecessary distinctly to disclaim the idea of God being "the soul of the world." It would seem as though he was fully aware, that a doctrine intended to do honour to the Deity, might, by incautious statements, be made to verge upon a dangerous and derogatory extreme.

Enough has now been said on those metaphysical questions which necessarily arise when our researches have for their object the ultimate constitution of bodies, but which are too little in accordance with the utilitarian character of your scientific and practical Journal, and too speculative and unprofitable in themselves, to dispose me much to hold any controversy upon them. I will only add, that I trust the course of reasoning pursued by me has been advanced with that diffidence which will become any one who undertakes to treat so difficult a subject, but which ought more especially to be felt by him who canvasses so freely the opinions of men of such pre-eminent abilities, and of such high authority, that even their *dicta* ought to be implicitly received, if it were not that a modest freedom of thought is the birthright of all.

I am, Sir, yours, &c.

BENJAMIN CHEVERTON.

March 30, 1835.

P. S.—Circumstances, which it is not necessary to mention, have greatly delayed this communication, and the same must form my apology for my not having replied to Mr. Frend's last article. It is probable that the cause of this neglect may continue to operate for some time to come; but I am consoled by the reflection that he is altogether in my arrears, by his refraining to notice any of my strictures on his remarks.

HOARE ON THE CULTIVATION OF THE VINE.*

The subject of this communication may seem more appropriate to the "Gardener's" than the "Mechanics' Mag.;" but I have long thought it desirable that we, who are "in populous cities pent," should be induced to devote some portion of our time to the simple operations of horticulture. The vine is particularly the poor man's fruit-tree: it admits of being trained in almost any situation, it flourishes in the suburbs of any large town, and its culture when rightly understood is of the simplest description, I say when *rightly understood*, for in the culture of no other fruit-tree is error so predominant. How constantly in the southern counties do we find a single vine running over the entire front of a cottage, its stem covered with moss, its centre filled with useless wood, and bearing at its extremities a few bunches of grapes that seldom ripen. An impression is very prevalent, even among gardeners, that the grapes are best the further from the root. The fact is, that, in the present mode of culture, it is only at the extremities that the vine can bear at all; the wood which has once borne fruit never bears again; consequently, if this be allowed to remain, the next year's

* Cultivation of the Vine on the Open Wall. By Clement Hoare. Published by Longman and Co., London; and Mason, Chichester.

produce is upon wood still further removed from the root, and in a very few years the vine presents the appearance I have before described, and uselessly occupies the space that might be productively occupied by a dozen. The peculiar merit of the system recommended in this publication, is the proportioning the quantity of fruit the tree should bear to its strength, as indicated by the circumference of its stem; for the vine does not possess the power of casting its superfluous fruit (like most other trees), and is generally injured by over-cropping: a series of experiments have enabled the author to determine this quantity with precision. His mode of pruning is that called technically long-pruning, and no more *eyes* are allowed to remain on the tree, than (by the scale) it is capable of maturing fruit. This little work contains a calendar of all the requisite operations, explained in so simple a manner, that I should think even the uninitiated cannot misunderstand them. I know the author of this publication, Clement Hoare, well: his vines are the admiration of all who visit them; and it is sufficient proof of the quality of the fruit to state, that it was sold in Brighton at 2*s.* 6*d.* per lb. From the attention excited by the lectures delivered by C. Hoare, before our Mechanics' Institution, a Society, for the encouragement of the growth of the vine on the open wall, and of wine made from its fruit, has been established in Chichester; and, at the annual dinner, last autumn, fruit was produced that would not have disgraced any gentleman's hot-house.

I am trying Hoare's plan pretty extensively at Grayling Wells, about a mile from Chichester, the result of which some time or other, I may communicate; and I send this communication for the widely circulating pages of the Mech. Mag., in the hope of benefitting a meritorious individual, and of inducing some of my brother tradesmen and mechanics to follow my example, believing that the culture of this valuable fruit may be extended with profit, and will increase the number of our cheap, innocent, and healthy pleasures.

HENRY WATSON.

Chichester, 4th Month 18, 1835.

THE UNDULATING RAILWAY CONTROVERSY.

We received, about four weeks ago, a reply by Mr. Badnall to the Report, on his Undulating Railway Theory, by Mr. Robt. Stephenson, jun., and also to the mathematical investigation by Mr. Whitehead, but deferred the publication of it in consequence of Mr. B.'s having formed an erroneous impression with respect to the manner in which Mr. Stephenson's Report found its way into our pages, which impression we felt it to be our duty to remove. Mr. Badnall seemed to feel hurt at the Report being published without some previous communication with him on the part of Mr. Stephenson, especially as he had sent an answer to that Report to the London and Birmingham Railway Directors. We, therefore, thought it right to apprise Mr. Badnall that the report was not published with Mr. R. Stephenson jun.'s sanction or knowledge—nor, to the best of our belief, with the sanction or knowledge of the Board of Directors; and such being the case, we suggested to Mr. B., whether it might not be better that he should remodel his reply, and satisfy the public of the fallacy of Mr. Stephenson's conclusions, by a more full investigation and criticism of them, than he seemed inclined to enter upon, while under his erroneous impressions as to the way in which the document was brought under the notice of the public. Since then we have received from Mr. Badnall an answer to our letter, wherein he expresses his satisfaction at hearing that Mr. Stephenson himself was not a party to the publication of his Report; and states that he will, with his earliest possible convenience, furnish us with such remarks as the Report would, under ordinary circumstances, have called forth, in defence of his position, especially with reference to the practical objections urged. He authorises us, in the mean time, to extract from his reply as it stands, a few paragraphs that will not be affected by the intended revision, and which contain some explanations that cannot be too soon made public.—ED. M. M.

"The promptness with which I generally reply to the remarks of my opponents on the 'Undulating Railway ques-

tion,' and the delay which I have permitted to occur in answering those remarks, since December last, may possibly induce some of your readers to imagine that I feel myself standing on marshy ground. Such, however, is not the case —I feel a solid footing beneath me—a footing which (in addition to the many other instructive attacks which have been urged against me—and I say *instructive* with every feeling of sincerity) has not been shaken, either by the respected talent of Mr. Whitehead, or the more known and more generally acknowledged talent of Mr. Robert Stephenson, jun.

* * * * *

"(Referring to page 211, vol. xxii.)—I have read Mr. Whitehead's communication with considerable attention and pleasure, and I do not hesitate to state that he is one of the fairest opponents with whom I have had the honour of contending. But I fully agree with a 'Lieut. of Engineers,' that '*he has grounded his solution on what I conceive to be a false principle; viz. that friction is the same at all velocities.*' If this *be* the case—if this *one point* can be *proved*, I will not only yield to the *virtual* accuracy of Mr. Whitehead's equations, but to the *virtual* accuracy of Mr. R. Stephenson, jun.'s value of *f*. But, with the greatest deference to the opinion of Mr. Whitehead, and with *far greater* (as being better known to me) to the opinion of Mr. Stephenson, I defy either one or the other to prove that *friction, over equal spaces, does not decrease as velocity increases.* I also agree with the 'Lieut. of Engineers,' in opposition to the opinion of your able correspondent 'Lewis Frend,' that no other inference can be deduced from the observations of 'Kinclaven' on this subject, than that he considers *friction on railways*, or, in other words, *the friction of rolling bodies*, to be proportional to the *times* and not to the *spaces*.

"If I be wrong on this point, I trust Kinclaven will set me right; but I do not hesitate to assert that, whatever *his opinion* may be—whatever mine—there never was a question which demanded a more speedy determination. It is sufficient, however, for my present purpose, that I should repeat that all my arguments have been founded upon the assumption *that friction is as the times and not as the spaces.*

"Entertaining such an opinion, Mr. Whitehead will at once perceive the uselessness of my combatting his second and third positions—both are founded on his first—and that, without hesitation, I proclaim untenable. * * *

"Mr. Stephenson says:—'In recommending the Directors to make such an experiment, those gentlemen (Drs. Dalton and Lardner) have evidently been influenced by the statement in the Memorial, that it would not cost over 500*l.*; and that the experiment, should it fail, would be productive of no detriment to the Railway Company. I have thoroughly considered the expense of such an experiment, and also the probable inconvenience that will arise out of its failure; and supposing the latter result, I am satisfied it could not cost the Railway Company less than 8,000*l.* or 10,000*l.*; and this sum may be made to appear without taking into the account many contingencies that would necessarily attend such a circumstance. The ballasting and laying the rails alone costs from 800*l.* to 1,000*l.* per mile, &c. &c. &c.'

"Now, in the *Memorial* to the Directors, such a length of road as that suggested by Drs. Lardner and Dalton was never contemplated; a *single* curve, or two curves (if expense were, on such an occasion, an obstacle, and such obstacle was not unforeseen), would not only have satisfied the memorialists, but, I have reason to believe, even Mr. R. Stephenson, jun., himself; and I fearlessly maintain, that such a curve, or such two curves, as would be requisite to decide the *whole question*, on *a line of road* now in progress, such as the London and Birmingham, would not, in case of failure, have cost the Company more than 500*l.* The opinions of Drs. Dalton and Lardner were written after the Memorial was drawn up; and I feel persuaded that neither of these gentlemen could have so far forgot themselves, or shown such a perfect want of practical knowledge, as to imagine, for one moment, that in recommending a trial on 10 miles of road, such trial could by any possibility be accomplished for the sum of 500*l.* It has always been my opinion that a single curve, if properly constructed, would be amply sufficient to try the leading merits of the question; and in all my conversations with Mr. R. Stephenson, jun., I have (decidedly against my own interest) proposed to

rest the whole merit on such a trial; for, although he never allowed that *time* was an element that should be taken into consideration, I offered to stand the trial upon the difference in *tonnage* which would be converged upon a level line and a curve, with equal power, without reference to velocity.—But I have done—if a Memorial, signed in one town only, by subscribers to the amount of 100,000*l*., could not induce the London and Birmingham Directors to patronise a trial of the undulating railway, I can only exclaim with Virgil, '*Fungar inani numere.*'"

MR. CLEGG, AND THE HISTORY OF GAS-LIGHTING.

Sir,—Your correspondent, L. L., who furnished the article concerning Mr. Clegg (in No. 607), states himself to be "one of his earliest and oldest friends," and that, in compliance with a request made to him, he undertook "to throw together a few reminiscences of his life and labours"—"fairly and impartially"—so as "to furnish materials for a truer history of the art of gas-lighting than have ever yet appeared. Happening to know Mr. Clegg, as well as his history, perhaps, quite as well as L. L. himself; and having devoted not a little attention to this subject, I am induced to send you a few remarks upon his statements. The account which I have given of Mr. Clegg's inventions, in my "History of Gas-lighting," is, I believe, both *fair* and *impartial*: the principal materials being also derived either from his own information, persons connected with him, or the statement that he published in 1820—as it appears in the Appendix to my History, p. 328.

Your correspondent, L. L., affirms, that "the gas was not displayed upon that occasion (the Peace of 1802), *in any devices* on the front of the manufactory (at Soho), as stated *by some writers* upon gas-illumination." What I have stated was from being a spectator of the illumination; and in a conversation with Mr. Clegg concerning it, a few years ago, he told me that *he actually constructed the device*, forming a crown on the cupola, in the centre of the establishment. L. L.'s description of the apparatus employed is altogether erroneous. The retorts to produce the gas were placed in the upper rooms of the building, and Mr. Murdoch is my authority for this statement. The illumination took place about the termination of Mr. Clegg's apprenticeship; yet L. L. states this to be the "*first*" circumstance that "directed Mr. Clegg's attention to the practicability of distilling gas from coal;" and that "*the next time* he witnessed lighting by gas was at the Soho foundry." The real state of the case, however, is, that the latter was lighted by gas as early as 1798; and as Mr. Clegg, then an apprentice, occasionally went there on business, about castings, &c., he must have repeatedly seen the lights, if not the apparatus; and I have now a letter before me, *from Soho*, affirming, that on one occasion Mr. Murdoch explained to him the apparatus and process employed.

L. L. affirms that, in 1805, he "transferred the gas into copper balls, and condensed it there, and this was the first *portable gas*." In Mr. Clegg's own statement, published in 1820, he mentions this as having been done in 1811, at Stoneyhurst College. (See my History, p. 329.)

Some other facts and dates of L. L. do not accord with those of Mr. Clegg, who, it may be presumed, really knew the circumstances of time and place, when and where his operations occurred, or his inventions exhibited, at the period of his publishing the account of them.

Allow me to remark, in conclusion, that Mr. Clegg, as well as several of his friends, have repeatedly applauded my detail of his operations and inventions, as being the most correct of any that had previously appeared. It was my object, in the "History of Gas-lighting," to do both to him, and every other individual, ample justice. In L. L.'s implied censure of "*some writers on gas-illumination*," he necessarily must include myself; but whether his knowledge of facts enables him "*to furnish materials for a truer history*," than that which I have written; or the few he has given, are more "fairly and impartially" related, than such as characterise my narration, I shall leave your readers to decide.

I am respectfully, Sir,

Yours, &c.

William Matthews.

April 14, 1835.

DAVIS'S IMPROVED MODE OF CHILLING CAST-IRON WHEELS.

We lately extracted, from a Report of the Directors of the Baltimore and Ohio Railway, a brief notice of an important improvement in the mode of chilling cast-iron wheels for railway cars. We now subjoin a copy of the specification of the inventor, Mr. Phineas Davis, of Baltimore, C. E.

" Whereas, it has been found that, in the casting of what are called chilled wheels, for railroad cars, the part of the wheel which is most liable to wear, namely, the rise, cone, or curve, between the tread of the wheel and the flanch, is usually less hard than the other parts, for the obvious reason that the metal is there less rapidly cooled by the chill.

" Those acquainted with the business of casting iron, are aware that the operation of chilling consists in placing within the mould, so as to make a part thereof, a piece, or pieces, of iron, which, when the metal is poured in, rapidly cools that portion with which it is in contact, and renders it hard. In the casting of wheels for railroad cars, the chill consists of an iron hoop, of considerable thickness, and with which the whole face of the wheel, including its flanch and tread, is in contact; but from its form, as I have already indicated, there is one part of it, uniting the tread with the flanch, which is less rapidly cooled than the others. To remove this difficulty, I employ what may be denominated an internal chill; this consists of an iron hoop, or ring, which I usually form of round rods, half an inch in diameter, giving to the hoop, or ring, such a diameter as shall cause it, when laid in the flask, and the casting made, to be surrounded by and completely embedded within, the cast metal, and to stand about half an inch within the body of that part of the wheel which forms the curve or cone, before spoken of, and opposite the centre thereof. But as, in the usual thickness of the rims of such wheels, the said ring would be covered on the inside by only a thin shell of metal, I form such a bead, projection, or thickening, opposite thereto, on the inside of the pattern of the wheel, as will cause the metal to cover it about three-eighths of an inch.

" Iron-founders are well acquainted with the means of supporting such articles as the before-described ring, within the flask, so that they may be embraced within the cast-metal. The method which I have adopted of effecting this in my wheels, is the following. I take four strips of iron, which may be one-tenth of an inch thick, one-fourth of an inch broad, and four or five inches long, and one end of each of these I bend round the ring so as to clasp it tightly, the remainder of the strap forming a shank, or bearing, which rests upon the sand in the lower flask. These clasps stand at equal distances apart, and, when in the mould, point toward the centre of the wheel. The pattern must be so made, that the parting of the sand in the flask will be opposite to the centre of the ring. Facing sand, of the usual description, should be used in making the mould. The ring, before being placed in the mould, should have its surface made bright by filing or otherwise. It must also be heated, say to the temperature of boiling water, to dissipate any moisture, or other evaporable matter, which might otherwise cause it to blow. The casting should be performed immediately after placing the ring in the flask.

" Although I have described the mode of procedure in casting, and in other parts of the process for forming wheels within which are imbedded a ring of wrought iron, I do not claim these as making any part of my invention; but I do claim the using of a hoop, or ring, of wrought iron, to be laid and cast within the body of a rail-road wheel, in such manner as to operate as an internal chill, to cool more rapidly, and consequently to harden, the part which I have described under the name of the curve, or cone thereof; I claim no more.

" PHINEAS DAVIS."

OLEAGINE, THE NEW SUBSTITUTE FOR OLIVE OIL.

Sir,—As you have always shown a laudable anxiety to propagate all useful inventions and discoveries, I send you the details of a very important discovery, for which I have taken out patents; it is for a composition called oleagine, as a substitute for olive oil.

The consumption of oil in the woollen manufactures of the three kingdoms, taken at the lowest estimate, is 10,000 tons per annum, which, at 60*l.* per ton is 600,000*l.*; by my process 450,000*l.*, or say 400,000*l.*, will be saved. These are staggering figures, but they are rigidly correct, as I shall now show.

Previous to obtaining the patent, I felt it right to put the composition to the test of actual experiment; and Messrs. Hannah and Co., of Huddersfield, having kindly consented to let the experiment be made at their mills, I went down there. 200 lbs. of wool, of three different qualities, were taken; viz. coarse, middling, and fine; and 100 lbs. of

each was treated by the old method, and 100 lbs. each by the new, when the following results were obtained :—

By the new method there was effected—

1. A saving of 75 per cent. in oil.

2. Ditto of five-sixths of the wool sticking in the cards.

3. Ditto of five-sixths of the time lost in cleaning the cards.

4. Two hours a day in slubbing, from the yarn breaking much seldomer.

5. Ditto of one-third of the soap used in scouring.

6. Ditto of one-third of the time required for milling.

The cloths when finished were found superior to the others, each weiged two-thirds heavier, and was nearly a yard longer, arising from the less quantity of wool sticking in the cards.

The pieces of cloth are now lying for inspection at Messrs. Hannah and Co.'s warehouses.

I may add, that the composition cannot injure the machinery, for it is neither acid nor alkaline.

As such an important discovery must necessarily yield the patentee more than enough to satisfy any ordinary ambition, I propose to allot 5 per cent. of all the sums obtained for licences, &c., to the education and maintenance of the children of workmen in the factories where the composition is used.

I am, Sir,

Yours very truly,

J. BYERLEY.

Chelsea, April 16, 1835.

SUBSTITUTE FOR INDIGO — FRESHENING OF SALT-WATER.

Sir,—The newspapers have, for some time past, abounded in (paid-for?) paragraphs, recommendatory of two claims to public patronage, which, as may be easily shown, are totally unworthy of it. I allude to the substitute for indigo, and the plan for rendering sea-water sweet. A few words will suffice to place them in their true light.

1. *The substitute for indigo.*—This is nothing more than a preparation of prussiate of iron, commonly called Prussian-blue. Samples of cloth, dyed by this process, were sent to Mr. Richard Phillips and myself, and each, unknown to the other, destroyed the colour. Indeed, nothing is more easy. Take a little pearl-ash, and dissolve it in water; dip the cloth into it, and the boasted blue becomes a yellow-green. In fact, it is well-known that no preparation of Prussian-blue will resist the alkalies.

2. *Rendering sea-water sweet.* — The inventor of this process pretends he can evaporate 17 lbs. to 18 lbs. of water with one-third of coal, besides cooking, &c. &c. &c. Now Mr. Watt never could evaporate more than 7 lbs. to 8lbs. of water, with his best constructed boilers, which had neither to boil, bake, nor roast, like this miraculous invention. I may safely defy the inventor to perform half what he promises. Besides, when he has condensed his steam, what does he produce? Fresh water? Yes, if by fresh water we understand water that is *not salt;* but if by fresh water, we understand good potable water, like either rain, river, or spring-water, *no.* The water is such as no one would drink but at sea, when no other can be had.

In short, these two projects are mere bubbles, and such they will prove.

Yours,

DETECTOR.

ADVICE TO EMIGRANTS.

Friends and Countrymen, — This paper relates only to your personal safety during your passage. You must often have heard that there are but two bad paymasters in the world—those who pay before-hand, and those who do not pay at all. Act strictly, then, upon this maxim. Do not pay your passage until you are landed at your destination. But, then, the shipowner will not receive you on board. This is a matter, however, which can easily be settled. It is because the shipowner doubts your means of being able to pay at all that he refuses to receive you on board, not that he can allege he has any just right to demand your passage money in advance, any more than he has to demand the freight of a bale of goods till it is delivered at its destination. In the case of goods, he can hold them till he get his freight, or is satisfied that he will be paid; but with passengers he has no such security, and hence the general practice of paying passage money in advance. Bargain, then, for your passage on the best terms you can, and intimate at the time

of bargaining, that the money will not be paid till you are landed at your destination. And to convince the shipowner or broker of your means of being able to pay, offer to pay the passage money, in his presence, into any bank of the port from which the vessel is to sail, in trust, in the name of the Government agent for embarkation of emigrants, the minister or elders of the parish, the magistrates of the town (any two of them will be sufficient), or any two respectable individuals on whom you can agree, and whose consent to act, however, must be obtained, to be drawn out on the order of these two individuals, or in the event of the death of either of them, on the order of the survivor, without requiring your consent, and to be paid to the shipowner, together with the interest which may have arisen on the sum, on satisfactory evidence being produced to these individuals of the vessel's arrival at her destination. Perhaps a paper signed by the proper authorities of the Custom-house at the port of destination, saying of what date the vessel arrived there, might be agreed upon as satisfactory proof. These might be sent home in triplicate, like bills of exchange. Get as many of your fellow-emigrants who propose going out in the vessel, and if possible all of them, to join you in this arrangement as you can. In order to remove any reasonable scruple of the shipowner, you should at once agree that the money shall be paid to him on satisfactory evidence of the vessel's arrival at her destination, without requiring a certificate of your being alive. This will be the same to him as if the money had been paid in advance, provided he perform his part of the contract,—if he do not, it is not legally due, whatever practice may be, and ought not to be paid. If one shipowner will not take you on these terms, there may be reason to apprehend that all is not right, and you should endeavour to get another who will. Competition for employment among shipowners will soon bring this matter right, although there may be some difficulty at first—once establish a precedent, and the practice will become general.*

The fatal experience of drowning emigrants last year, and in former years, proves that no reliance whatever is to be put on the bond to the extent of 1,000*l*. come under by the shipowner that the vessel is seaworthy. No man in Britain knows what being seaworthy *is*; and hence the penalty never can be sued for; and it is rather too late for emigrants, after they are drowned, to find out what it is *not*. As little reliance is there to be put on seamen engaging to go with the vessel. Many of them are ignorant of the hazard they are about to run, and, with too many of them, it is merely a question of employment at the risk of their lives or starvation; and they will prefer employment, even at the hazard of their lives, to starvation ashore. The *Montreal Gazette* of June last, gave a list of eighteen British vessels wrecked on their passage out; and the newspapers of the present day, state that a thousand emigrants were drowned last year on their passage from the British islands to Canada, and other parts of the American continent. Keep in mind, too, that in a public conveyance by land, if an insufficient vehicle, careless or incompetent driving, or defect of any kind can be proved, the injured party has an action at law, and can recover damages to the extent of the injury received, from the proprietor. But at sea, under the plea that all casualties whatever arise from the ACT OF GOD, unsafe ships are employed, and although you may be providentially preserved from being drowned, you have no recourse against the shipowner. A practice is known to exist of insuring vessels for far above their *marketable* value, and in such circumstances, when they are lost, the owner makes a gain by it. He is further safe in the event of loss, if he be full-handed with passage money. All losses by shipwreck, where the vessels are insured, are paid by the public; and hence underwriters have no interest in diminishing them, as they charge the premium in proportion to the risk. It should be your endeavour, then, to guard against going to the bottom along with the vessel; and withholding payment of your passage money until you are landed, will give the shipowner an interest in your safe conveyance. Instructions should be left to whom your passage money is to be paid, in the event of loss and never reaching your destination. In such event, and in the circumstance of your having no friends to whom you would wish it to be paid, it would be far better to pay it to the poor of any parish, or even to put it in the fire, than that it should be a means of temptation to hurry you into eternity. If you could discover to what extent the vessel you are about to embark in is insured, it would be a great means of ascertaining the probable chances of your safe conveyance, always taking it as a general rule, that the less sum insured upon the vessel, the greater the chance of your safe conveyance. Wishing you a quick and safe passage to more prosperous climes, I am your well-wisher and a friend to humanity.

JAS. BALLINGALL,
Ex-surveyor of shipping at
Kirkcaldy,

Kirkcaldy, March, 1835.

* A precedent, directly in point, exists in the case of passengers sent from the Scotch Corporation Charity of London, one of which has recently gone through the writer's hands.

LIST OF NEW PATENTS, GRANTED BETWEEN THE 28TH OF MARCH AND 23D OF APRIL, 1835.

Francis Humphrys, York-road, Lambeth, civil engineer, for certain improvements in marine steam-engines, which improvements are also applicable to steam-engines for other purposes. March 28; six months to specify.

Philip Augustus de Chapeaurouge, Fenchurch-street, London, for a machine, engine, or apparatus, for producing motive power, which he denominates a self-acting motive power, and is called, in France, by the inventor, Voland Moteur Perpetuel, being a communication from a foreigner residing abroad. March 31; six months to specify.

John Fenton, Sydenham, Kent, for a composition or material to be used as, or as a substitute for, soap. April 3; six months to specify.

Henry William Nunn, Newport, Isle of Wight, lace-manufacturer, for improvements in manufacturing the ornamental parts of lace, and producing the ornamented or embroidered lace. April 3; six months to specify.

Robert Gillespie, Piccadilly, Middlesex, for improvements on trusses, or in instruments for the cure of hernia or rupture, being a communication from a foreigner residing abroad. April 3; six months to specify.

George Edmund Donisthorpe, Leicester, and Henry Rawson, of the same place, hosier, for certain improvements in the combing of wool and other fibrous substances. April 3; six months to specify.

James Hardy, Wednesbury, Stafford, for a certain improvement or improvements in the making or manufacturing of axletrees for carriages, and other cylindrical or conical shafts. April 6; six months to specify.

Miles Berry, Chancery-lane, civil engineer and mechanical draftsman, for certain improvements in the construction of rotary steam engines, being a communication from a foreigner residing abroad. April 8; six months to specify.

Miles Berry, Chancery-lane, civil engineer and mechanical draftsman, for certain improvements in the construction of printing machinery or presses, being a communication from a foreigner residing abroad. April 9; six months to specify.

Hugh Ford Bacon, Christ College, Cambridge, for an improved apparatus for regulating the flow of gas through pipes to gas-burners, with a view to uniformity of supply. April 9; six months to specify.

Samuel Parker, Argyll-place, Regent-street, for an improved metallic air and water-stop and stopper. April 14; six months to specify.

John Ingledew, Edward-street, Brighton, engineer, for an improved metallic safety-wheel and revolving axle. April 14; six months to specify.

Joseph Whitworth, Manchester, engineer, for certain improvements in machinery for spinning and doubling cotton, flax, wool, silk, and other fibrous substances. April 14; six months to specify.

Henry Booth, Liverpool, for compositions or combinations of materials applicable for the greasing of the axle bearings of carriages, and the axle spindles and bearing parts of machinery in general, which he intends to denominate the patent axle grease and lubricating fluid. April 14; six months to specify.

James Boydell, Jun., Dee Cottage, Chester, for improvements in machinery or apparatus for tracking or towing boats and other vessels. April 14; six months to specify.

Alexander Stocher, Yeovil, Somerset, for improvements in machinery for manufacturing horse shoes, and certain other articles. April 14; six months to specify.

Godwin Embrey, Lane Delph, Stoke-upon-Trent, potter, for improvements in ornamenting of china, glass, and earthenware. April 14; six months to specify.

Sir John Byerley, Whiteheads Grove, Chelsea, for a composition which will effect a considerable saving in oil and soap used in the woollen manufactories, being a communication from a foreigner residing abroad. April 22; six months to specify.

John M'Curdy, Southampton-row, for an improvement or improvements for generating steam, being a communication from a foreigner residing abroad. April 23; six months to specify.

William Kemp, Burslem, Stafford, for a machine for raising sunken vessels. April 23; six months to specify.

NOTES AND NOTICES.

French Railways.—The following railways are now in operation:—1. From St. Etienne to the Loire, 13 miles 1194 feet. 2. From St. Etienne to Lyons, by St. Chammond and Givors, 37 miles 1495 feet. And 3. From Andrezieux to Roanne, 42 miles 1341 feet. Two others are in the course of construction, namely from Alais to Beaucaire, 43 miles 2624 feet; and from Epiney to the Canal of Burgundy, 17 miles 2105 feet.—*Journal de Commerce.*

Lockerbie Sheep Show—Steam Navigation.—At the show of live stock, especially sheep, held at Lockerbie, in Dumfries-shire, on the 19th March, the attention of the border sheep-feeders was drawn to the facilities which the introduction of steam navigation gave to them, for disposing of their stock in the English market, and more particularly in Liverpool. Not fewer than from 20,000 to 30,000 of the half-breed sheep (Leicester and Cheviot) of that district are every year sent to the midland counties of England to be disposed of, in the month of April, at the spring fairs; and it was strongly recommended that a part at least of these sheep, instead of being sent in one mass, by land, should be despatched by the steam-boats plying between the Nith and the Mersey to Liverpool, during the months of April, May, June, and July, as the demand and the prices might render it profitable. Should this suggestion be attended to, it will add considerably to the import of live stock into this port, and perhaps affect the price of butchers' meat in this neighbourhood. How strange a revolution this is, by which the Dandie Dinmonts of the Scottish borders are made the purveyors for the people of Lancashire. It is another of the thousand triumphs of steam-navigation.—*Liverpool Mercury.*

Indian Ink.—An easy and expeditious method of providing a substitute for Indian ink, is to boil parchment slips, or cuttings of glove leather, in water, till they form a size, which, when cold, becomes of the consistency of jelly; then having blackened an earthen plate, by holding it over the flame of a candle, mix up with a camel-hair pencil the fine lamp-black thus obtained with some of the above size, while the plate is still warm. This black requires no grinding, and produces an ink of the very same colour, which works as freely with the pencil, and is as perfectly transparent as the best Indian ink. It likewise possesses the advantage of furnishing artists with a substitute for that article, which may be prepared where it may be difficult to obtain the ink itself.

Drawing on Cloth.—A new method of drawing on cotton and linen cloth has lately been invented by Mr. John Buck, of 12, Parker-street, Westminster, which possesses, as far as regards the portability and durableness of the material, a great superiority over every other yet devised. The cloth is first prepared by rubbing into it an adhesive composition, which unites the threads, and makes it as easy to draw upon as paper; and after the drawing has been made, it is done over with a "thin pellucid liquid," or varnish. It might be supposed that cloth thus treated would be stiff and liable to crack; but, on the contrary, it admits of being folded of any shape or size, with the greatest ease, and without injury. A whole estate, or township, as the inventor observes, "may, by this means, be introduced into a land-agent's pocket-book."

New Boiler.—Messrs. Petherick and West, of the Lanescot Mine, Cornwall, have invented and brought into use a boiler of a new construction, which is stated, in the last Annual Report of the Cornwall Polytechnic Society, to effect such an economy in the consumption of fuel, as to raise the duty performed by an engine to between ninety and a hundred millions of pounds! In Watt's time *nineteen* millions was considered prodigious. The improvement consists principally in having a horizontal cylindrical tube enclosed within the tube which contains the fire. Water is supplied to this inner tube from the feed pump; and the steam and heated air pass from it to the boiler, whence it is conveyed to the steam-pipe.

Berlin Iron Castings rivalled.—At the last annual exhibition (at Falmouth) of the Cornwall Polytechnic Society, the first prize in the Fine Arts was awarded to Mr. Nicholas Harvey, of Hayle, for some miniature statues cast in iron, which were pronounced by Mr. Davies Gilbert, the Vice-patron of the Society (a good judge), to be equal to the best productions of the Berlin school.

Col. Macerone has sent us a note in reference to our review of his "Expositions and Illustrations," in which he says—"I do not know exactly what to say, until I see whether you publish or not my brief reply to H.'s note in No. 607, which reply of mine you announce the receipt of in No. 608, and so I expected to see it in 609 or 610, where it is not! I should also like to know whether you think proper to identify yourself with your correspondent H., and mean to say that you and he are one and the same person. I am induced most respectfully to ask this question, because among the innumerable mistakes in your oration, there is one of personal identity. You are pleased to take to yourself expressions which, at pp. 93 and 101 of my pamphlet, I clearly and nominatively apply to your correspondents H., Verax, &c." We have, in answer, to inform Col. M., that H. and the Editor of the Mechanics' Magazine are *not* one and the same person; and that we do *not* intend publishing his "brief reply" to H.'s note, because the whole of the matter in dispute between Col. M. and H. has been already disposed of by the extracts which we gave from Col. M.'s last pamphlet. The offensive expressions, which we are said to have erroneously taken to ourselves, were these:—"Had I stopped short for want of coke, what would have been the cry or yell of *the* writers in the Mechanics' Magazine, and other of my inveterate persecutors."—p. 93—"A periodical work, certain writers in which have all along evinced a most unaccountable, wanton, and ferocious disposition to calumniate and injure me."—p. 101. What else could we infer from such expressions as these, but that they were intended to apply to the Editor as well as to his correspondents? The Editor has, besides, no wish, and sees no occasion to wish, to separate himself from his correspondents on the present occasion. He can see no material difference between an Editor's being personally guilty of calumny and persecution, and allowing his columns to be made use of for such purposes by others; and he must, in justice to himself as well as to his correspondents H. and Verax, and to the general character of his work, positively deny that any thing has ever appeared in its pages to warrant Col M. in ascribing any other than that best of motives—a love of truth—to "*the* writers in the Mechanics' Magazine."

Halley's Comet.—A letter from Vienna announces that M. Littrow, director of the Observatory in that city, has received from the celebrated English astronomer, Herschell, now residing at the Cape of Good Hope, the remarkable intelligence that Halley's comet, of which so much has been said, and which is positively expected in August this year, will not be visible, because it has long since changed the direction of its course, and now revolves in a different orbit. A report by our astronomers, on this important subject, it is expected, will soon be published.—*Dutch Paper.* Dutch fudge!

Black Lead Pencils.—A M. Fichlemberg, of Paris, has invented a combination, which is said to possess all the desirable qualities of the pure plumbago of Cumberland.

Claims of Music.—The strictures of "Cui Bono," on the academic honours obtainable by professors of music at Oxford and Cambridge, smack of an ultra-utilitarianism, which has not, we hope, many followers. Is he aware that Haydn was, *for his music alone*, elected a member of the French Institute—that most scientific and (probably) most universally respected of all learned institutions?

The Pneumatic Railway shall have full justice done to it in our next.

Mr. Clark's address is, 7, Nelson-terrace, City-road.

Mr. Beams has our best thanks. He will find the articles alluded to in Nos. 162, 167, 178, 179, 195, and 201.

Communications received from Mr. Woodhouse—Mr. Baddeley—Mr. Laudale—Mr. Andrews—B. D. Z.—Amicus—E. E.—C.

The Supplement to our last Volume, containing Titles, Index, &c., with a Portrait, on Steel, of Samuel Clegg, Esq., C. E., is now published, Price 6*d.*; also the Volume complete, in boards, Price 8*s.* 6*d.*

Our Publisher will give double price for copies of Nos. 236, 237, 238, 239, 256, 258, and One Shilling and Sixpence each for copies of the Supplement to Vol. X.

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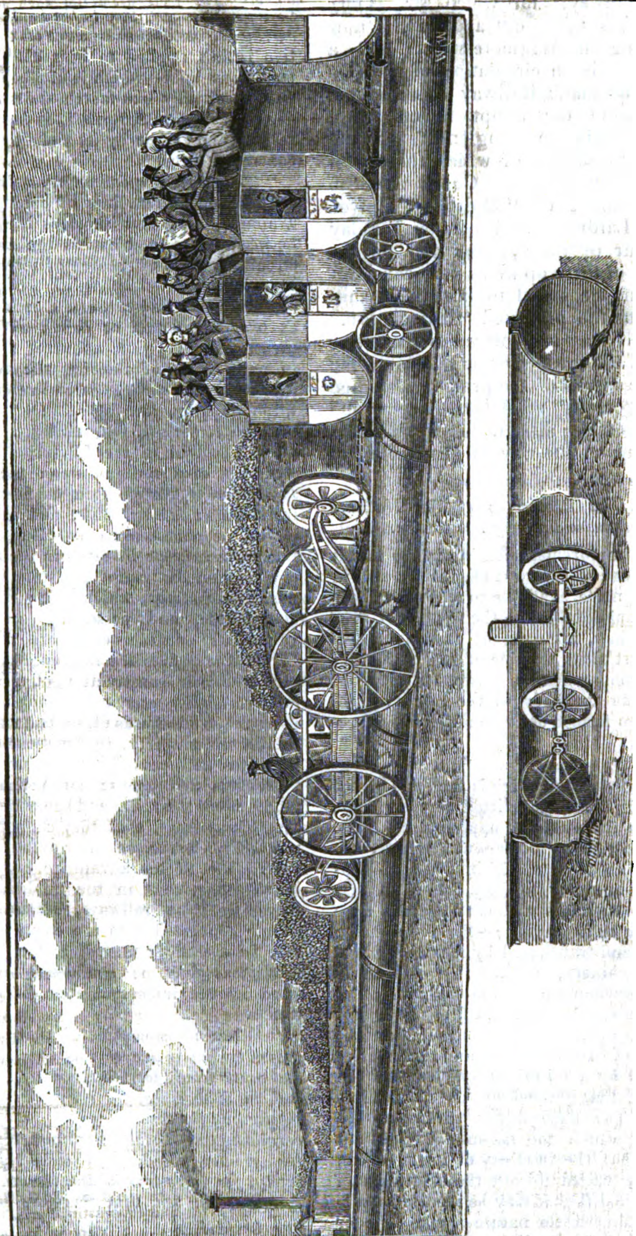

THE PNEUMATIC RAILWAY.

THE PNEUMATIC RAILWAY.

A model, of what is called a "Pneumatic Railway," for which Mr. Henry Pinkus has taken out a patent, is now exhibiting in Wigmore street; and a prospectus is in circulation of a "National Pneumatic Railway Association," to promote the adoption, on "all the railroads in England," of the system of transport of which this model is an exemplification. Copies are also handed about of "Opinions" given by Dr. Lardner and Professor Faraday in favour of the system; and on the strength of these opinions very considerable sums are stated to have been subscribed to the projected "Association." We shall first lay before our readers as much of the prospectus as relates to the scientific merits of the project, and then the "Opinions" of Messrs. Faraday and Lardner entire; after which we shall add something in the way of an opinion of our own.

Extracts from Prospectus of the National Pneumatic Railway Association.

"The improvement consists in the means by which one of the most effective powers in nature is made available to railway transit, and it is applied through the agency of *fixed* steam-engines, arranged at stations *several miles* apart along the line of road; the medium of communication between the stations constituting the body of the railway itself, which is so formed as to be nearly indestructible.

* * * * * * *

"The invention, which is the basis of the improvement now submitted to the public, consists in the means of applying the elastic and forcing power of the atmosphere, obtained by rarefaction, within a hollow cylinder, of from thirty to forty inches in diameter, to carriages and cars *running upon rails on its outer surface;*—the action being produced and transferred by means of pneumatic machinery, worked by sufficiently powerful fixed or local steam-engines.

"Steam-power, used as a first mover, admits of no application so economical as that by means of fixed engines; and thus motive power will be obtained at one quarter the expense of that yielded by the locomotive-engine. The fixed engine gives also the advantage which the locomotive does not possess, that the intensity of its force can be greatly varied to suit the exigencies of the road; and thus it may be rendered available according to the nature of the slope or steepness of the acclivity to be overcome, the weight to be moved, and the degree of rapidity required. Unlike that of the locomotive-engine, the power of the fixed engine is, *by the improved system*, communicated *with no indirect expenditure to the load or train of carriages;* whilst the power of the locomotive is first applied to bear along its own ponderous bulk—which is of about 10 tons weight, or fully one-fourth of its usual load—and, as before remarked, it destroys both railway and engine by its violent action and concussive force.

"*The power of surmounting acclivities* renders the most direct lines of communication available, and thus shortens the distances between places, and avoids the necessity of circuitous routes in search of levels. Moreover, the improved system of railway permits of roads being laid through a marsh as well as over a common or down, and with no greater expense; thus affording the means, in many cases, of avoiding the annoyance, inconvenience, and expense of running roads through parks, and over arable lands. It may be remarked, too, that the great expense involved in the formation and construction of a railroad upon the common system, is totally sunk in cutting down, or in tunneling through hills, and in building across, or embanking over valleys; whereas the main expense involved in the formation of a road on the improved system, is in common iron castings, which being almost indestructible, and possessing an intrinsic value, little or no loss can accrue upon them.

"Not only does the improved system present a firmer construction of the railway, and a highly economical application of power, but it affords also greater protection to life and property, in the security of the carriages and cars for the conveyance of passengers and goods; since these are so placed upon the rails, and so connected with the railway itself, that they cannot, by any possibility, be thrown off or overturned. In consequence of this advantage, whatever objection may exist in the public mind to travelling upon railways, because of the danger connected with the common system, will be entirely removed, and a great improvement may be confidently calculated upon in the important item of passenger traffic.

"When it is considered that *by the improved system a line of road may be formed and constructed, for, at the most, two-thirds, and in some cases, for one-half the expense involved by the common system;* and that *such a railway can be maintained and worked with far greater speed, and infinitely greater safety, for three-fourths less than the common system costs;* and that therefore *passengers and goods may be conveyed at one-half the price which the common system demands, and then yield a far greater profit,* competition

with the Association will be wholly out of the question.

"As *any degree of speed* can be obtained by the improved system with the most perfect safety, and without the disadvantage, not to say danger, arising from great velocity on the common method, a single line on the new system can be made, by the reciprocating plan proposed, to effect as much transit as can be effected by the use of a double line on the former, while the cost will thereby be lessened nearly one-half. Hence communications that may not warrant the expense of a double line of railway, may be advantageously occupied with a single line; numberless lines are in this manner open to the application of the new system, which the common method will not permit of being attempted.

"As the invention affords the means of applying the power to the common railway, the proprietors of such must soon be found anxious to avail themselves of its advantages; and thus all the railroads in the country may soon become tributary to the Association, while the interests of the various concerns themselves will be materially improved by its adoption."

Prefixed to the prospectus there are two views, of which those on the front page of our present Number are reduced copies; Fig. 1, representing the Pneumatic Railway, as it would appear in actual operation; and Fig. 2, a sectional view of the Railway Cylinder, exhibiting the internal arrangement.

Opinion of Dr. Lardner.

I have read the specification of the patent for the Pneumatic Railway and the accompanying papers, and have also examined the drawings and models which have been submitted to me by Mr. Hocking.*

Two methods have been heretofore employed for rendering steam power available in transport upon railways; one by causing a travelling or locomotive engine to move with the load which it draws, the other by constructing, at intervals of about a mile and a half, stationary steam-engines, the power of which is transmitted to the load by a rope carried along the road upon rollers or sheaves placed between the rails. The train being attached to this rope is drawn by the power of the engines from station to station. The object of the Pneumatic Railway is to substitute for the rope a partially exhausted tunnel, to employ the fixed steam-engines to work air-pumps by which a rarefaction of the tunnel shall be maintained, and to cause the trains to be tracked upon the railway by connecting them with a diaphragm or piston placed in the interior of the tunnel, so as to have that part of the tunnel in advance of the piston rarefied by the engines, while that part behind the piston is open to the atmosphere. An effective impelling power is thus obtained equivalent to the difference between the pressure of the atmosphere on one side of the diaphragm, and of the rarefied air on the other. ! ! !

Of the *practicability* of this project, I think there can be no doubt. The working of large air-pumps, by an adequate moving power, and the rarefaction of air in tubes or tunnels by such means is not a new idea. It was suggested by *Papin* in the latter end of the seventeenth century, and was even pointed out by him as a means of *transferring power to a distance*, without the loss by friction and other causes consequent upon the use of ropes, or other ordinary means of transmitting force. It is, in fact, a well understood principle in physics, that whatever moving force be expended in producing the rarefaction of air in a cylinder or tunnel, must necessarily be followed by a corresponding force on the other side of a diaphragm moving air-tight in that tunnel, and exposed to the free action of the atmospheric pressure. In the present case, supposing the structure of the valvular cord and the pneumatic piston to be perfect, the opposite side of the diaphragm will always be pressed by an effective impelling force, the amount of which may be calculated upon these principles. It will, of course, be perceived that no original moving power is obtained from the tunnel, or from the rarefied air; the rarefaction gives back the power expended by the stationary engines, and nothing more; and the tunnel must therefore be regarded merely as a substitute for the ropes in the common method of working railways by stationary engines. But it is evidently attended with several advantages in comparison with the latter. A very large proportion of the moving power of stationary engines worked by ropes is intercepted by the resistance from the weight and friction of the ropes, sheaves, barrels, drums, &c. All such waste of power is removed by the pneumatic tunnel.

The original expense of ropes, and their wear and tear, would be likewise saved. Some notion of the extent of this saving may be collected from the following facts:—when the Liverpool and Manchester Railway was about to be brought into operation, a question arose as to the expediency of working it by stationary engines, and estimates of the expense were made by competent engineers. The total amount of capital to be invested in mov-

* Professional Director of the undertaking.—Ed. M. M.

ing power was estimated at about 120,000*l.*; of this above 25,000*l.* was devoted to ropes, sheaves, drums, and other necessary accompaniments. The total annual expense of maintaining the moving power was estimated at 42,000*l.*, and of this about 18,000*l.* was appropriated to the wear and tear of ropes, sheaves, &c. &c. Thus it appears that the method of transmitting the power of the stationary engines to the trains by ropes would absorb about 20 per cent. of the invested capital, and their maintenance would consume about 43 per cent. of the annual expenditure.

Another source of comparative economy would obviously be the diminished number of stationary engines. In the estimate already referred to, it was calculated that the distance of 30 miles should be divided into 17 stations, with two 40-horse engines at each station; besides these, there would have been two engines at the bottom of each inclined plane, one at the tunnel, two at the top of the planes, and one at the Manchester end, making in all 42 stationary engines to work a line of 30 miles. Now, according to the estimate of the patentee of the Pneumatic Railway, from three to six stations would be sufficient between Manchester and Liverpool, and the whole line would be worked by from six to twelve steam-engines. Putting aside, therefore, the saving of power which would arise from the substitution of suction in the tunnel for ropes, and supposing the amount of stationary power in both cases to be the same, it will be evident that a material saving would arise from the circumstance of that amount of power being derived from so much less a number of engines—the number of enginemen, assistants, &c., besides the interest on capital, being considerably less.

Some notion of the economy of power likely to arise from superseding the use of ropes may be collected from the result of experiments made by Messrs. Stephenson and Locke, on the resistance arising from the friction of ropes. They found that a load of 52 tons, drawn by stationary engines worked by ropes, through mile and half stages, offered a total resistance amounting to 11,56 lbs.; of this 582 lbs. arose from the friction of the load, and 574 lbs. from the friction of the ropes. In the case of the Pneumatic Railway, the friction of the rope is replaced by the friction of the air-pumps and of the impelling apparatus; and it will be evident that the latter, compared with the former, must be almost insignificant. Hence the power wasted in its transmission from the stationary engines to the load, which in one case amounts to 50 per cent. of the whole moving power of the engine, in the other is of comparatively trifling amount.

Slopes on railways will always be objectionable, whatever power be used; for even the most gentle ascent will increase the resistance of the load in an enormous proportion. The difficulties, however, which they present are materially less when the line is worked by stationary than by locomotive-engines, and would be still further diminished by superseding the rope; the resistance arising from the rope being always greater on inclined-planes than on the level, owing to its increased thickness and consequent weight. A load which requires a 4½-inch rope for the level requires a 5½-inch rope upon a slope of 1 in 100. The weights of equal lengths of these ropes would be in the proportion of about 2 to 3, the slope requiring one-half more weight of rope than the level. Besides this, the moving power on a slope, in addition to the ordinary friction which it has to overcome on the level, has likewise to draw up the weight of the rope—a resistance which will be increased in proportion to the acclivity of the slope.

The disadvantages produced by slopes when locomotive-engines are used are still more formidable. The same engine which is fitted to work upon the level is altogether inadequate for the slopes; the consequence of which is, either that the locomotive is strained beyond its power by working up the slopes and rapidly destroyed, or that the engines must be more powerful than is requisite for the common level of the road, and thus power and expense wasted; or finally, that an auxiliary engine must be kept constantly ready at the foot of each slope, with its fire lighted and its steam up, ready to help up the trains as they arrive. Unless the trains be almost incessant (which even on the most frequented railroad they never can be), this last expedient, which is the one adopted on the Manchester line, is attended with great waste of power and expense. Stationary engines worked on the pneumatic principle would effectually remove all these difficulties and objections.

The weight of the trains which could be drawn upon the Pneumatic Railway, and the speed of the motion imparted to them would entirely depend upon the power of the stationary engines. As the friction or other resistance does not increase with the velocity, the same absolute expenditure of power would draw the same load at whatever speed. The high speed attained by locomotive engines has been attended with great expense, but this has not arisen from the increased expenditure of power. It has been caused by the wear of the engines themselves, consequent on their rapid motion on the road, and by the necessity of sustaining a fierce temperature in the fire-place, in order to be able, within the small compass of these engines, to generate steam with sufficient rapidity to attain the necessary rate of motion. As the

magnitude of the stationary engines would not be limited, and as they would not be subject to the injurious effects of motion on the road, steam could be produced in sufficient quantity for the attainment of any required speed, without increasing its cost or in any way impairing the machinery.

One of the obstacles to the attainment of great speed by stationary engines worked by ropes, is the delay produced in transferring the trains from engine to engine, and from station to station. The momentum imparted to them is lost at each change, and these changes occur every mile and a half, so that the train has scarcely attained its requisite speed when its motion must again be checked in order to hand it over to another engine. This difficulty is removed by the pneumatic system; there being no rope to be detached and attached, the engine passes on by its momentum from station to station; and a contrivance is provided, by means of a valve at the stations, by which it is brought under the operation of the next engine without stopping its motion.

Although the danger of accidents to passengers on the present railways, worked by locomotive engines, is considerably less than that of travelling by horse coaches on turnpike roads, yet serious accidents have occasionally occurred. These have generally arisen either from the locomotive engine running off the rails—from one train running against another—from the locomotive engine breaking—or, finally, from persons standing upon the rails being run down. In the pneumatic system there is almost a perfect security from these causes of danger. From the engines being stationary, and the tunnel rising between the wheels of the trains, it is evidently impossible for the carriages to run off the road; and from the manner in which the system is worked, it is impossible that one train can run against another. It happens also that the nature of the rails themselves, forming, as they do, merely ledges upon the sides of the tunnel, prevents the possibility of persons standing between or upon them.

In railways worked by stationary engines, serious accidents have occasionally occurred by the ropes breaking while the train has been ascending a slope. In such cases the train has run down by its weight with a frightful rapidity, producing the destruction of the carriages and the loss of life. It is evident that this source of danger is removed by the pneumatic system.

An advantage possessed by this system above the edge railroad deserves to be particularly noticed. In the edge railroad the engines and carriages are kept upon the road by flanges or ledges raised upon the tires of the wheels which press on the interior of the rails. Every thing which causes the carriages to press on the one side or the other, causes these flanges to rub against the rails. When a curve or bend happens in the road, the carriages are guided by the pressure of one or the other flange on the side of the rail, which, of course, is accompanied by considerable friction. In the pneumatic railway there are no flanges, either on the wheels, or rails; the carriages are guided by wheels or rollers placed in a horizontal position, and acting upon the external sides of the channel which receives the valvular cord. By this means all resistance which arises from what is called rubbing friction is removed, and every surface which moves upon another moves upon it with a rolling motion.

It is well known that notwithstanding the prosperous condition of the Manchester Railroad Company, yet their expenditure in locomotive power has been so enormous, as to cause considerable anxiety on the part of the Managers; and some of them have even inclined to the opinion, that the question of stationary power deserves to be reconsidered. This opinion would probably be confirmed and strengthened, if the practicability of the pneumatic system were satisfactorily demonstrated by experiment upon a sufficiently large scale.

On the whole, it appears to me that if the mechanical difficulties of maintaining the pneumatic tunnel sufficiently air-tight be overcome, the system presents a fair prospect of being practically successful. These difficulties are not so great as they may at first appear. It should be recollected that nothing approaching to the *exhaustion* of the tunnel can be necessary; nor even any considerable degree of rarefaction. Supposing the tunnel to have an internal diameter of 40 inches, the impelling diaphragm would have a surface of about 9 square feet. If in such a tunnel a degree of rarefaction were produced sufficient to cause a barometric gauge to fall 2 inches (which would be an extremely slight degree of rarefaction indeed), an impelling force would be obtained amounting to one pound on every square inch of the surface of the diaphragm, which would give an impelling force of more than half a ton. It is calculated that on the common railways the amount of load is above 200 times the force of traction, and it would therefore follow that this force would be sufficient to draw a load of 100 tons. If an additional inch of mercury be made to fall in the barometric gauge to balance friction, &c., still the rarefaction would be extremely inconsiderable, and the contrivances to prevent leakage

would appear to be attended with no great mechanical difficulty.

From the various reasons which I have above stated, I am of opinion that the present project would, if carried into execution, be likely to be attended with greater economy and safety than any other method of working railways now practised; and I see no reason against the attainment of as much speed as is obtained by the locomotive engines. At all events, having explained the reasons on which I have grounded this opinion, every one can judge to what weight it may be entitled. The project would appear to be well deserving of trial on some railroad of limited length, such as that between London Bridge and Greenwich, where it would be sufficient to have stationary engines at the extremities. In such a case, I see scarcely any limit to the speed which might be attained with safety; and the economy, as compared with locomotive engines, would probably be very great.

DION. LARDNER.

London, Feb. 19, 1835.

Opinion of Professor Faraday.

Mr. Hocking to Professor Faraday.

44, Berners-street, Jan. 26, 1835.

Dear Sir,—As you have witnessed the experiment upon the improved or pneumatic system of railway, and expressed a highly gratifying opinion of its merits, I am anxious to be permitted to cite you as an authority on those important points on which you can speak most confidently, and on which alone its practical application depends.

The efficacy of the power is, of course, indisputable; and it is but to witness the experiment, as you have done, to admit that the mode of its application which this improvement embodies is equally simple and certain.

To put the power which nature supplies in action, and apply it to the object, local steam-engines are employed, as these yield the services of the gigantic force of steam in the cheapest possible manner. Local steam-engines possess, moreover, this further important and valuable quality, that the intensity of the force may be greatly varied upon them, so that they may be worked at a low pressure for levels and descents, and be increased in their effect to almost any extent to work acclivities.

The possession of the means of increasing the active force as the occasion may require, obviates the necessity of obtaining a level, or even a near approach to a level; and as it is this necessity which involves the enormous expense of cutting down or tunnelling through hills, and of embanking across valleys for the locomotive system, the advantage of obviating it needs only to be pointed out to be admitted.

In the mechanical construction of the railway, whilst the cylindrical form which is given to the body, and its inflexible continuity, make it independent of artificial foundations, the attachment of the rails to the cylinder upon its horizontal diameter gives them the important advantage of being at once inseparably connected, and totally independent of extraneous or artificial support.

Besides the general stability which the peculiar form and mechanical construction of the improved railway give it, the system upon which it is worked renders it free from any tendency to derangement, since the carriages run along upon the rails with the even and unexciting pressure of the load alone; and this system employs no ponderous locomotive-engine, whose violent concussions might promote any such tendency, nor is the railway burdened with an incumbrance which wastes upon its own unprofitable weight a large proportion of the power it brings.

The attachment of the governor, or external carriage of the travelling apparatus, to the dynamic traveller within the body of the railway, and its connexions with the railway itself, are such as to preclude the possibility of its being thrown off; and as the train of carriages must follow the governor, and every carriage has its peculiar attachment, their security is absolute. Indeed, it appears to me difficult to suppose an accident arising from the railway itself, or from the mode of transit, or that could happen to either, that could have the effect of rendering the carriages insecure, or even affect in the slightest degree their safety.

I do not trouble you with questions as to the cost of formation and construction, as that is a mere matter of estimate;—the fact that the power employed is capable of being increased at pleasure, to overcome acclivities, shows an important saving in the most expensive item; and in working a railway, the difference between the expense of local and locomotive steam-power alone, is so beyond all comparison in favour of the former, that no one at all conversant with the subject will require evidence of the great advantage in point of economy to be derived from its use.

Your confirmation of the correctness of the views herein stated will much oblige,

Dear Sir,
Your faithful servant,
WILLIAM HOCKING.

Michael Faraday, Esq., F. R. S.,
&c. &c. &c.

Professor Faraday to Mr. Hocking.

Royal Institution, Feb. 3, 1835.

My dear Sir,—The points in your letter of the 26th of last month, which you put to me for an opinion, are such that I have no hesitation in agreeing with you upon *them*.

To enumerate briefly these points:—the *principle* of communication of power is correct—the use of local steam-engines is highly advantageous, both for cheapness of force, and capability of varying it when required—the necessity for levels will, I presume, therefore be greatly obviated—the association of cylinder and rail is such, that the whole road must (with sufficient thickness in the cylinder) have great strength and firmness—the absence of locomotive-engines removes much of the cause of derangement which the road would have to sustain—and I do not see how the governor and carriages can leave the railway.

You know my objection to giving a general opinion in reference to the profitable application of the plan in question; but I may here add, that the reserve I feel originates simply in my possessing no *practical* knowledge of the construction, expense, and profit of ordinary railroads.

I am, my dear Sir,
Very truly yours,
M. FARADAY.

William Hocking, Esq., F. S. A.,
&c. &c. &c.

Remarks.

" The working of large air-pumps by an adequate moving power, and the rarefication of air in tubes or tunnels by such means," is, as Dr. Lardner observes, " not a new idea," having been " suggested by Papin in the latter end of the 18th century." But Dr. Lardner should have stated, that Papin not only " suggested" the " idea," but attempted to reduce it to practice—*and completely failed*. Papin proposed to drain a mine by a water-power situated at the distance of about a mile. His first plan for this purpose was to make the water work a piston, which compressed the air in a cylinder till it had acquired a very high degree of density; the compressed air was then allowed to escape into a long, narrow pipe, which communicated with another cylinderat the mouth of the mine. Papin expected that the result would be the forcing up of a piston fixed in the last-mentioned cylinder, and connected with the lifting-pump of the mine. The apparatus, however, would not work; no degree of compression which he could effect at one end would raise the piston at the other. Papin then tried the reverse of the operation; instead of condensing air, he exhausted it (as Mr. Pinkus now proposes to do), anticipating that the immense velocity with which air rushes into a vacuum would produce a rapid and effectual communication of power. But the failure in this case was as complete as in the other.

Nor is Papin the only person who has attempted to obtain a motive power in this way. It is related by Dr. Robison that, a good many years afterwards, there was " erected a machine in Wales, at a powerful fall of water, which worked a set of cylinder-bellows, the blow-pipe of which was conducted to the distance of a mile and a half, when it was applied to a blast-furnace. But although care was taken to make the conducting-pipe completely air-tight, of great size, and as smooth as possible, *it would hardly blow out a candle*. The failure was ascribed to the impossibility of making the pipe air-tight. But, what was surprising, above ten minutes elapsed after the action of the pistons in the bellows before the least wind could be perceived at the end of the pipe; whereas the engineer expected an interval of six seconds only."

Still later—even as recently as 1826—Mr. John Vallance proposed, by exhausting the air out of a tunnel, or series of large pipes, to propel carriages with passengers and goods, at an unprecedented degree of speed; and actually exhibited his scheme in operation, on a small scale, at Brighton. After much talk, however, of the wonders it was to perform, it came also to nothing. (See Mech. Mag. vols. vii. and viii.)

The " Pneumatic-Railway" of the present day is nothing more than a revival of Mr. Vallance's abortive project, with a slight modification. The principle on which the power is to be obtained is precisely the same; the only difference between the two plans is that, according to Mr. Vallance's, the carriages were to run *within* the cylinder—close at the heels of the vacuum—to be shot through, as it were — while, according to Mr. Pinkus, they are to run on the *outside*, the vacuum-power being transferred to them by means of what Dr. Lardner calls the

"valvular cord." Which of these would be the better method of propelling the carriages it is unnecessary to inquire, since it is tolerably clear, from previous experience, that they cannot be propelled (within economical limits) at all.

Dr. Lardner states, that it appears to him, on the whole, that "*if* the mechanical difficulties of maintaining the pneumatic-tunnel *sufficiently air-tight* be overcome, the system presents a fair prospect of being practically successful." The experiments of Papin and the Welsh engineer show, that the difficulty of keeping the tunnel air-tight is by no means the only or indeed principal, difficulty in the case. In Mr. Vallance's experimental pneumatic-tunnel there was an open space of an inch left all round the frame which carried the carriage; and yet the carriage was shot to and fro very effectually (for the distance). The grand difficulty to be overcome—that which makes all others of comparatively no moment—is the difficulty of acting on a column of any considerable length, of so thin, subtle, and elastic a fluid as air. Papin could make no useful impression on a column a mile long; yet Mr. Pinkus talks gravely of the facility of managing a column of air "several miles long," and Dr. Lardner as gravely recommends that a trial of the scheme should be made on the London and Greenwich Railway—about three miles long—for which purpose, he says, it would be "sufficient" to have stationary or exhausting engines "at the extremities." "Sufficient" indeed! Yes, just as sufficient, and no more, as the Welshman found his blowing cylinder; as that could "hardly blow out a candle" at the distance of a mile and a half, so neither of the two engines would be able to stir a feather at three.

It is admitted by Dr. Lardner, that in any event, no more power can be gained behind the impelling diaphragm than is requisite to produce the exhaustion in front; and that "the tunnel must be regarded merely as a substitute for the rope in the common method of working railways by stationary engines;" but he justifies his preference of the pneumatic-railway on the ground, that "in the case of the pneumatic-railway the friction of the rope is replaced by the friction of the air-pumps and of the impelling apparatus," and "that the latter compared with the former must be almost insignificant." Dr. Lardner, however, has here forgotten to take into account the friction of the column of air—"several miles" long—against the inside of the cylinder; neither has he made any allowance for the greater difficulty of acting upon a column of air than upon a line of rope.

The wear and tear of hempen ropes is certainly very great; but they will, at least, do the work that is assigned to them; while Mr. Pinkus's aerial substitute could not be worked at all.

From the statements in the prospectus, it would seem as if the projector imagined that his cylinders could be laid down in a direct line across a country without ballasting, tunnelling, embanking, or any thing of the kind; as if he thought that it would matter nothing whether they were laid down firmly or loosely, straight or crooked! He claims absolutely "the power of surmounting acclivities," that is, the power of ascending any plane whatever, with any number of tons' weight at his back, (by simply exhausting the air at the upper end of the transit tube!) in spite of gravity—in spite of every law of nature and of common sense.

Dr. Lardner, the great sponsor of the scheme, does not indeed go so far as this. He asserts only that the difficulty of ascending acclivities "would be still farther *diminished* by superseding the rope (of hemp)." But *how* diminished he does not explain, and would probably find it difficult to do.

A stationary engine has only to be made large enough to be able, with the help of a connecting rope or chain, to pull up a plane of any degree of inclination, as great a weight as was ever conveyed on a level railway; but no engine that could be set to work at the upper end of one of Mr. Pinkus's cylinders, placed at such an angle of inclination, would ever, though worked till doomsday, be able to pump up a single hundred weight, of such stuff as men and merchandise are made of.

The scheme is altogether a most preposterous one; and, were it not for the countenance which it has received from such men as Dr. Lardner and Professor Faraday, would be quite unworthy of notice.

HUNTER'S PATENT.

In March last, a patent was granted to Mr. James Hunter, of Leys Mill, Arbroath, "for certain improvements in the art of cutting, or what is commonly called facing and dressing certain kinds of stone." The specification of Mr. Hunter's method has not yet been enrolled; but from a Report, with a copy of which we have been favoured, made to the proprietor of the Leys Mill Quarries (W. F. L. Carnegie, Esq.) by Messrs. Carmichael and Kerr, engineers, of Dundee, who were invited to see the method in actual operation at these quarries, and to verify the results, it appears to be immensely superior to any other hitherto devised. Mr. Hunter has seemingly realised that great desideratum, a power-machine for the cutting and dressing of stone, capable of withstanding the extraordinary friction to which it must be necessarily subjected. The dispatch with which immense blocks of stone are cut up and dressed, by Mr. Hunter's apparatus, is prodigious; yet the cost of tools is next to nothing—"only a halfpenny-worth of steel for every hundred feet of planed surface!"

Report of Mr. Charles Carmichael, and Mr. John Kerr, Engineers, Dundee, on the power of Mr. James Hunter's Stone-planing Machine.

Sir,—Agreeably to your desire, we have visited Leys Mill Quarries, and attended minutely to the performance of the stone-planing machines. These machines do their work most effectually, as the following experiments, which we witnessed, will testify.

Experiment First.

We went to one of the machines that had six stones laid on the bench, one of which was planed, and the second begun to be operated upon; while this was doing we took the dimensions of the other four stones, viz.:—

Number of Stones.	Length of Stones,		Breadth of Stones.		Thickness.	Finished Thickness.	Quantity taken off.
	Feet.	*Inches.*	*Feet.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1	5	3	2	6	3½	2½	1
2	5	0	2	8	3	2⅜	⅝
3	5	6	2	6	6	4¼	1¾
4	4	0	2	3	4	2½	1½

The average thicknesses of the above stones are given, but many parts of them were much more than the thickness stated. One of the broad finishing tools was blunted ere the experiment began, and was changed when No. 2 was in the operation of being planed. No. 3 was a very hard stone, and was what is technically called yolk, in planing which one of the roughing tools broke at the point; still it wrought out the stone, and was then replaced. A splinter came off the face of the last stone, when about half-finished, which was another cause of delay, as they had to go over it again; but, notwithstanding the delay occasioned by the breaking of one tool, by another being changed, and by having to go over the one-half of the last stone twice, yet the time altogether was forty-five minutes, being at the rate of sixty-five superficial feet per hour.

Experiment Second (same machine).

Five stones were now put on the planing machine, of the following dimensions, viz.:—

Number of Stones.	Length of Stones.		Breadth of Stones.		Thickness.	Finished Thickness.	Quantity taken off.
	Feet.	*Inches.*	*Feet.*	*Inches.*	*Inches.*	*Inches.*	*Inches.*
1	4	3	2	2	4¼	2¼	2
2	3	9	1	10	4¾	3½	1½
3	3	4	2	8	6	4	2
4	3	6	2	0	6½	4¾	1¾
5	3	8	3	6	5½	4½	1

These stones were planed in forty-two minutes.

The above stones were taken from the quarries without selection, and the men that were

working the machine were not informed of the object of our visit. Experiment First began at half-past twelve o'clock, noon, and Experiment Second was concluded at nine minutes past two; thus leaving twelve minutes for cleaning and reloading the bench of the machine. Had all the stones been $5\frac{1}{2}$ feet long, they would have been planed in exactly the same time, for the machine travels the distance for that length; so that nearly sixty-seven feet of surface would have been planed in forty-two minutes.

The stones, as they come from the machine, are remarkably smooth and straight on the face; and were it not for the shade left by the tools, we would be apt to think them polished, as they feel as smooth as a polished stone.

We were told by the foreman that, during the last week, there was planed* 4,400 superficial feet, more than half of which was planed on both sides (indeed more than half of all the stone that leave the quarry are planed on both sides), by four machines. We saw the pay-list for the week; the amount was.. £6 1 6

Add blacksmith for dressing and grinding tools..................... 0 12 0

£6 18 6

We were further informed by the manager that, during the last summer, there were upwards of 100,000 feet of pavement planed by four machines; and there was one thing that struck us most forcibly, which is the small degree of wear on the tools. Three shillings a week, or sixpence per day, is the cost of the labour for dressing and grinding the tools of one machine; and the whole consumption of steel during the last year was under a hundred weight, so that, if we measure both sides of those stones that were actually planed on the two sides, it will be seen a pound of steel will plane 1,500 feet, or about a halfpenny-worth of steel for every 100 feet of planed surfaces.

There are now five machines working in the quarry, wrought by a steam-engine of six-horse power, the steam cylinder of which is 16 inches diameter, stroke 2 feet. Besides the machines, the engine has to work two inclined planes, one of which is for dragging up the pavement from the quarry to the machines; the distance on the incline 48 feet, ascent 1 foot in 5; average quantity about thirty tons per day of ten hours.

The second incline is for dragging up the rubbish from the quarry to the place where it is deposited; distance 87 feet, ascent 1 foot in 4; quantity from 50 to 60 tons per day of ten hours.

The above shows what the engine is actually doing; and we have no hesitation in saying that the engine would work eight machines besides the inclines, without being overloaded; and our opinion is that a machine, on the average, is not much more than one-half horse-power. We are, Sir,

Your most obedient servants,

CCARMICHAEL,
JOHN KERR.

To W. F. L. Carnegie, Esq., Kimblethmont, Arbroath.

Note by Mr. Carnegie.

To explain the difference which is apparent between the quantities of planed stone, which according to the statement of the engineers, *might* be produced in a given time by the machines, and the quantity stated to them as in one week actually sent to market, it is necessary to remark,—1st, That it is found in practice to be cheaper to dress the stones by the machine in the rough state and shapeless form in which they are taken from the quarry, and to square them by hand afterwards, than to follow the opposite course, as is done where the whole work has to be performed by hand; thus a great quantity of work measured by the engineers, but not available in the market, is nearly lost. 3d, A considerable quantity is required to be dressed over twice on one side, or on both sides, according to circumstances; thus the stones, No. 3, in Exp. 1, and Nos. 2, 3, 4, 5, in Exp. 2, being too thick, were redressed on the under side to suit the market. 2d, The quarry does not always afford stones of a size to fill the benches, when much power is lost, as the machine has to traverse the whole width. 4th, Other circumstances (such as bad weather, &c. &c.), which will readily present themselves to the minds of those conversant in these matters, always occur to prevent general results from attaining the extreme limit, which may be calculated as possible, from the data of a short experiment. Mr. L. C. having been present, can confidently testify as to the correctness and impartiality with which these experiments were conducted, and to the truth of the information furnished to the engineers, by those in his employment.

* See subjoined Note by Mr. Carnegie, on this point.

NEW AFRICAN EXPEDITION OF DISCOVERY.

It is truly surprising that, in an age of enterprise and inquiry like the present, there should exist in any quarter of the globe a vast blank of 35° of latitude, by 20° to 40° of longitude—comprising a meridional section of between 2,000,000 and 3,000,000 square miles—of which, and of the people inhabiting it, we are nearly as ignorant as if it were located in another planet. Yet such is literally the fact; for, notwithstanding the numerous attempts which have been made at different times, by enterprising individuals, to penetrate into the interior of the African continent, but a few portions of it, here and there, extending only a small way beyond the coasts, have been hitherto explored. An expedition of discovery on a much larger scale than any yet attempted, with larger means, and more comprehensive views, seems to be still wanting, in order to lay open this vast continent to the knowledge of the rest of the world. For, if African discovery is to progress as it has done for the last three centuries—not less than *two-thirds* of it having never, even to this day, been trod by civilised man—three times three centuries more will probably glide away before the deep darkness which overhangs this portion of the earth will be completely dispelled. If so immense a *terra incognita* exists (and we could almost suppose, from its being so long overlooked, that it did *not* exist), the only question which can arise is, not as to the expediency, but as to the means, of exploring it. There are not wanting some, who calmly anticipate that Africa will become explored by degrees, and look on every attempt to arrive, by any shorter cut, at so desirable a consummation, as involving a needless and unjustifiable sacrifice of human life. But such persons might as reasonably lament that tea, coffee, sugar, and other tropical productions, were ever added to the list of European luxuries (may we not rather now say, *necessaries?*), because of the thousands of lives which have hitherto been sacrificed in adventuring across the seas for the purpose of obtaining them. Others, again, there are, who urge that the entire exploration of Africa, or rather to attempt to penetrate entirely through Africa, embraces too arduous and extensive a field for any feasible scheme of geographical discovery. But we may class these objectors with those who depict Africa as a region of deserts, and as having no navigable rivers; while the fact is, that we want but the enterprise to explore a country as fertile, in all probability, as any in the world, and to trace her rivers, many of which (as Captain Owen's recent exploratory voyage has set forth) are navigable for many hundreds of miles.

For all these reasons, it gives us no ordinary satisfaction to observe, that a subscription is on foot for fitting out an expedition, which shall penetrate quite through the interior of Africa, from the *South* towards the *North*. We allude to that of which Mr. W. F. Hoar is the projector, and intended conductor; and which numbers among its patrons, the Duke of Somerset, the Earl of Munster, Lord Bexley, Sir Alexander Johnston, Dr. Olinthus Gregory, and other distinguished philanthropists and men of science. The plan of operations which Mr. Hoar and his party propose to follow, is to proceed as a well-organised and equipped caravan, able to locate for a season here or there during the rains, and to set out from the well-known healthy districts of the South, so that they may become gradually inured to the difficulties of African travelling, previously to entering the more perilous field farther to the North, and thus have an ample opportunity of estimating their resources, and of putting the adequateness of their outfit to a thorough test, before they are so far involved as to render retreat or succour impossible. The country through which they will endeavour to shape their course, is that included within the point where Major Denham, in conjunction with Captain Clapperton, terminated his discoveries in the North, and the point where Messrs. Campbell, Burchall, and others, terminated theirs in the South; comprehending, as has been already stated, a meridional line of not less than 30° of latitude.

The project is one which, whether it be regarded in a scientific, a philanthropic, or merely commercial point of view, can scarcely fail to excite universal attention, and to interest deeply almost every member of the British community. There are numberless active spirits, who, for their own sakes, or for the sake of others, are ever looking abroad for some

new sphere of operation; but where, on the right hand, or on the left, is there so immense a prospect of success for all, as in Southern Africa? When we meditate on the proba ble results of discovery in this quarter, as connected with the interests of humanity, we cannot help feeling that the condition of Africa, whether as regards her past wrongs, or her future hopes, appeals to us with a mighty force; but we should, at the same time, feel well content to rest the claims of this expedition to the support of the British public, on the pecuniary advantages alone which would flow from the opening of so new and vast an outlet to the products of British industry; remembering well, what the history of mankind attests, that commercial intercourse with a country is the grand master-key to the civilisation of its inhabitants.

It is intended, we understand, to raise the pecuniary means required for the outfit of the expedition, at the hands of the *many*, rather than of the *few*. The plan is notable. And what is an individual mite of subscription, compared with the voluntary exertions and privations which are to be made by the parties about to prosecute the expedition—services proffered without stipulation for reward, beyond the honour which may be due to successful discovery? Great will that honour be, if a part only of what is undertaken be effected. We do not hesitate to pronounce the exploration of the unknown regions in question, as, perhaps, the greatest geographical discovery which yet remains to be made.

P.

MR. BARLOW'S EXPERIMENTS ON RAILWAY BARS.

When Messrs. Barlow, Wood, and Rastrick, the judges appointed by the Directors of the London and Birmingham Railway, to award the premium offered by them, for the best form of railwav bar, chair, &c., reported that certain of the patterns were the best of those produced* (see Mech. Mag. No. 608, p. 5); they stated, at the same time, that they were unable to recommend any of them *for trial*, owing to "the want of data for determining which of the proposed rails would be strongest and stiffest under the passing load; and whether permanently fixing the rail to the chain, for which there were several plans, would be safe in practice." No experiments on malleable iron having ever been made bearing on these points, they "considered it better to leave the question unanswered, than to recommend on no better ground than mere opinion an expensive trial, which might ultimately prove a failure." Seeing, however, how desirable it was that such data should be obtained, Mr. Barlow proposed to the Directors, to undertake a course of experiments with that view, provided the Lords Commissioners of the Admiralty, would allow him the conveniences for the purpose, afforded by the dock-yard at Woolwich; and that the Directors would supply such instruments, materials, and workmanship, as might be found necessary. The Admiralty immediately granted the requisite permission; and at a public meeting of the proprietors of the Railway, held at Birmingham, on the 13th of February last, a resolution was passed, embodying Mr. Barlow's proposal. Mr. Barlow then commenced his projected experiments, which he arranged into four divisions. The object of the *first* series was, to determine the extension of an iron bar of given area, under different degrees of tension, and hence the force with which the same bar will contract with a given reduction of temperature; of the *second*, to ascertain the comparative resistance of malleable iron to extension and compression, and thereby the position of the neutral axis; of the *third*, to find out the figure of the area of section, which gives the greatest strength with the same quantity; and of the *fourth*, to discover the strains, which bars of given sections are capable of sustaining, without injury to their elastic powers. A paper containing the whole of the details of these experiments was delivered by Mr. Barlow to the Directors, accompanied by a Report, containing what may be termed a popular view of the results arrived at, and some practical suggestions for the future guidance of the Company. The Directors have expressed their high approbation of Mr. Barlow's labours, and with their sanction they are now made public for the benefit of all other Railway Proprietors.*

* The successful competitors were, we understand, Mr. Dug!ish (Nos. 3 and 8), and Mr. Swainburn (No. 5).

* Experiments on the Transverse Strength and other Properties of Malleable Iron, with Reference

The reader can, of course, desire no better summary than that furnished by Mr. Barlow himself in his Report, of the results which his experiments have established.

"It has been ascertained (page 27), that a malleable iron bar of any length is extended $\frac{1}{10000}$th part of its length by a direct strain of a ton per inch on its sectional area; and that, when strained with ten tons per inch, or when stretched $\frac{1}{1000}$th part of its length, its elasticity is injured, and the bar will not return to its original state.

"Now, as the contraction of iron, between summer and winter, amounts to $\frac{1}{2000}$th part of its length, it follows, that the bars cannot be fixed permanently to the chairs and blocks, without great danger of drawing so much upon their strength, as materially to impair their efficiency for bearing a great passing load.

"It follows also as a consequence, that if the rails and chairs must not be permanently fixed to each other by direct means, it ought not to be attempted by indirect means, viz. by cotters, keys, or wedges; for, either these will hold the rail to the chair, or they will not. If they do hold fast, they produce all the mischief which permanent fixing would occasion; and if they draw, then they do no good, although they may still do mischief. Whence I am led to conclude, that the rails should have no greater attachment to the chairs than is sufficient for preserving them steady while the load is passing.

"My next experiments were directed to finding the position of the neutral axis in malleable iron; for without this datum, the strength of rails, of differently-formed transverse sections, cannot be computed and compared with each other, at least, without the expensive mode of having them first made, and then their strengths found by experiment. In this inquiry, as in the preceding, I have succeeded to my entire satisfaction; and, by the results obtained, have formed rules of very simple character, which will enable any person to compute with great precision the bearing strength of a bar of any proposed section within the limits of its elastic or restoring power, and also the amount of the deflection it will sustain under this or any lesser load. I have demonstrated by these means, that we may find certain practicable forms of parallel rails, which shall be, weight for weight, equally as strong as the fish-bellied rail, when loaded at their middle point, and, of course, stronger in every other part. For which reasons, and for others I have explained in page 66, I feel fully convinced that the parallel rail formed according to the requisite proportions, is decidedly the best."

to its uses for Railway Bars; and a Report founded on the same, addressed to the London and Birmingham Railway Company. By Peter Barlow, F.R.S. 97 pages, 8vo. Fellowes, London.

The novelty and importance of these results will be at once recognised by all who are familiar with railway practice. The opinions of engineers have been hitherto much divided with respect to the comparative advantages of fish-bellied and parallel rails. Mr. George Stephenson, and his son, Mr. R. Stephenson, advocate the superiority of the fish-bellied form; and it is, accordingly, that which has been adopted on the Stockton and Darlington, Liverpool and Manchester, and other railways executed under their direction. Mr. Vignoles, on the contrary, prefers the parallel rails, and has introduced it into the Wigan, St. Helen's, and Dublin and Kingstown railways. As Mr. Barlow's opinion in favour of the latter will now probably be considered decisive of this much agitated question, we shall place before our readers those "reasons" for it to which he refers in the preceding extract.

"It appears, that it is always possible to produce a parallel rail of good practical proportions, which shall be as strong as a fish-bellied rail of the same weight; and this being the case, I am decidedly convinced, after hearing and well weighing every argument that has been advanced in favour of the latter form, that the parallel rail is the best.

"First.—Because, although it is not stronger nor stiffer in the middle point than the fish-bellied rail, it is both stronger and stiffer in a very sensible degree in every other point.

"Second.—The deflection of a parallel rail during the passage of a load is less every where than in the middle, which is not the case in the fish-bellied rail. The rise and fall of the carriage, therefore, after passing over a support, is more rapid in one case than in the other; and to this, rather than to a want of equable strength throughout, I am disposed to attribute the many failures of fish-bellied rails within a short distance of their point of support. There is, however, or has been hitherto, an actual want of equable strength towards the point of support in rails of this form, which cannot fail to have facilitated these fractures; but which Mr. Stephenson, by a judicious and scientific distribution of the metal, has avoided, and no doubt such fractures would be with his rail less common; but the objection I offer above, applies not merely to the fish-bellied rail, but to the truly elliptical form itself, if it were possible to arrive at it.

"Thirdly.—The parallel rail is the best, because it enables the engineer to keep the blocks and chairs of the two rails directly opposite to each other, so that the wheels of the carriage shall pass over both supports at the same time—a point, I believe, not hitherto much attended to, but which is, I conceive, of great importance. There can be no doubt the motion of a locomotive-carriage consists of a succession of ascents and descents; and it must be evident how much easier and better the motion would be, to have the opposite wheels both rising and both falling together, than to have one always rising while the other is falling, and the contrary. The difference is similar to that of a vessel keeping her head to the waves, and crossing their direction obliquely. And every one who has never been further than Margate must have experienced this difference.

"It may be observed that the waves of the railway, or the deflection of the rails, are very small; but I would observe also, that the weights and velocities of the carriages are very great, and that it is very desirable every possible cause of momentum should be removed, particularly when it is as easy to do it as not to do it, as is the case with parallel rails, because they can always be cut to determinate lengths, but which cannot be done in the fish-bellied rail, in consequence of the occasional slipping of the bar in the rolls. At all events, their length cannot be varied at pleasure, which the former will admit of, and which is necessary, in going round sweeps, to preserve the blocks always parallel. For example, in going round a sweep of 800 feet, to keep the supports parallel, the rails of the inner course require to be about an inch shorter than the outer ones, and they are as easily cut into lengths of fourteen feet eleven inches as of fifteen feet, which is not practicable in the other form.

"The above is my decided conviction relative to the longitudinal figure of the rails. I entered upon the inquiry without prejudice; I felt sensible of the honour which the general meeting had done me in confiding the question to my investigation; and I have given to it (after obtaining the requisite data) all the attention necessary to arrive at a certain conclusion."

There are some additional observations in the "Report" on the importance of keeping the blocks of the two lines of rails parallel, which are eminently deserving of attention.

"It is probable I shall be considered by many as entering into refinements neither called for nor practicable, in the case of railways; but I would ask, why is it found that so much breakage takes place, and that so many repairs are rendered necessary? There is no theoretical reason why a heavy load, passing with great velocity, should cause more damage than the same load passing slowly, if the road were perfect; the mischief, therefore, is in the imperfect practical execution, and the disregarding small inequalities, as we would disregard them in common cases. It has perhaps never occurred to such persons, that a difference of level at a joint chair, between the two abutting rails of only $\frac{1}{10}$th of an inch, will, when the carriage is moving from the higher to the lower level at its greatest speed, cause the wheel to pass the distance of a foot without pressing on the rail, and consequently threw the whole weight, which ought to be borne equally by the two rails, wholly upon one; yet this is a fact resting on a natural law, and cannot be otherwise. To fall $\frac{1}{10}$th of an inch by the action of gravity requires $\frac{1}{44}$th part of a second, and in that time the carriage will have advanced a foot; consequently, for that space the whole weight has been borne by one rail only. It may be said there are springs provided, which assist gravity to bring down the wheel. I am afraid, however, after allowing for their inertia, that such aids are very inefficient; at all events, they furnish no arguments against having every thing as accurate as possible. Again, with reference to the abutting rails, I was certainly surprised when a gentleman, officially attached to the Manchester and Liverpool Railway, informed me, that in some parts of their line, the rails were half an inch apart, and that it was not thought injurious. But why, I would ask, whether injurious or not, have them half an inch apart, when they never need be open above $\frac{1}{10}$th of an inch; and, for more than half the year, not above $\frac{1}{20}$th of an inch, if proper care be taken in laying them down? Hitherto an idea has prevailed, that in laying down the rail, $\frac{1}{8}$th or $\frac{1}{10}$th of an inch must be left for expansion, and whether hot weather or cold, the same allowance is made; consequently, if the rail is laid in the summer, the $\frac{1}{8}$th of an inch becomes nearly a quarter of an inch in the winter, provided the contraction takes place in the same direction in two adjacent rails; but if in a contrary direction, it becomes half an inch, or nearly so, as my informant states the fact occasionally to be. To prevent this, I would, as stated at p. 31 of my experiments, have each rail fixed to one chair, and to one chair only; and I would have three steel plates, the thicknesses of the proper spaces, to be left between the rails, according to the temperature—one between 15^0 and 35^0, another between 35^0 and 65^0, and another for all temperatures above 65^0, whereby to regulate the distances of the rails. This, again, will, I have little doubt, be considered an unnecessary refine-

ment; but to such objections I reply, that this accuracy costs nothing additional in the execution, and may therefore, at all events, be as well attended to as not."

The proportions to be observed in the construction of parrallel rails, must depend, of course, on the magnitude of the weights which they are likely to be required to sustain. The rules which Mr. Barlow gives for calculating the bearing capacity of rails of this description are, as he states, of a "very simple character," and illustrated by some examples worked out at length, and in so plain a manner, that any person, with a knowledge of common arithmetic, may understand them. Of these examples, that numbered 4 seems to be the one which approaches nearest to Mr. Barlow's *beau ideal* of a good rail. Its proportions are as follows :—depth throughout, 4½ inches; thickness of rib, $\frac{7}{10}$th of an inch, and of bottom web, 1·39; weight, 50lbs. per yard. The strength, or absolute elastic power of a rail of this form, is equal to eight tons; the degree of deflection with that weight, being only ·55 (less by ·11 than a fish-bellied rail of the same weight). Now supposing the extreme weight of a locomotive carriage to be 12 tons, the greatest weight likely to be thrown on one rail would be 6, being two tons less than the weight which such a rail is capable of bearing. Mr. Barlow recommends, however (page 93), that in such a case the strength should be raised to 9 tons, so as to leave a surplus of 50 per cent.; and he thinks it possible, by the following slight modification of the above form of rail, to obtain that strength, *without any increase of weight*:—

"I have allowed rather more metal for the head, I believe, than is generally employed, which, if transferred to the lower web, would give all the additional strength required; or, perhaps, the centre rib might bear a slight reduction. At all events, leaving every thing as it is, except adding 2lbs. per yard to the bottom web, the rail would come up to the whole strength of 9 tons, as required. And here, I would observe, is the great advantage of working by rule rather than by opinion, for if we had only the latter to guide us, we should be hard to believe that an increase of $\frac{1}{25}$th in the weight could be made to add about ⅓th to the strength and stiffness of the bar; yet such is unquestionably the case."

Practical men may possibly hesitate to follow rules so much at variance with the notions hitherto prevalent among them; and some may even continue, as heretofore, to believe in the infallibility of "the Pope of Railway Engineers,"* and to regard all dissentients from his authority as theorists and visionaries: but they will, one and all, do well to observe, that there is nothing recommended in this publication of Mr. Barlow's which has not for its basis *actual experiments*, of a far more varied and comprehensive description than can have fallen within the experience of any other individual whatever. "I have not," says Mr. Barlow, "exami e d the question on theoretical, but on mechanical principles, with a view to one specific object, and have purposely avoided testing any point on mere hypothesis. Every thing is made to depend on experimental results; and from the uniformity and agreement of these, I have every confidence the rules founded on them will enable practical men to compute such cases as may occur with all the precision that can be desired."

NOTES AND NOTICES.

Grand Irish Railway.—The English Government is said to have taken the bold resolution of transferring the foreign packet station from Falmouth to Valentia, a harbour situated in that part of Ireland which extends the furthest into the Atlantic ocean, and about 200 English miles from Dublin. In order to connect Valentia with the Irish capital and its new harbour of Kingstown, an iron railroad will be made, the execution of which will be entrusted to Messrs. Vignoles and Cubitt. The Government gives a large sum to this undertaking, in order that the railroad may be laid down, as nearly as possible, in a straight line, without regard to the towns lying between, which, of course, will not fail to obtain, by means of branch railroads, a participation in the immense advantages of so speedy an intercourse with the capital. It is calculated that, by means of the steam-packets (and railways ?), the mails and passengers will be conveyed in thirty-one hours, by way of Liverpool and Dublin, from London to Valentia; from which place the packets, without being exposed to the dangers of the channel, may immediately put to sea, and thus reach Canada, the West Indies, the Mediterranean, &c., in a far shorter time than they can now calculate with certainty on doing. This plan will be of infinite advantage, not only to England and Ireland, but to the communication of all Europe with the other quarters of the globe.—*Hanoverian Journal.*

The American Boundary Commission.— Sir, I observe, in your 605th Number, page 447, a notice respecting the American boundary; and the claim advanced on the part of the United States (by Dr. Hassler, their surveyor) to apply the principle of geocentric latitude, in determining the line North of Vermont and New York, lat. 45°, and from the Lake of the Woods to the Rocky mountains on the 49°, the rest of the line being determined by dif-

* Vide Parliamentary Evid. Great Western Railway Bill.

ferent and natural points. This claim was successfully combatted by the British Commissioners and their able and scientific surveyor, Dr. TIARKS, F. R. S., *and not Dr. Watson*, as erroneously stated in the article referred to. I am sure it will afford you pleasure to correct the error. Dr. Tiarks wrote several able papers on the subject, and is a gentleman well known to the scientific world. Having, for many years, enjoyed the pleasure of his personal acquaintance, I should be sorry the public were induced to bestow the merit that belongs to him on Dr. Watson, however deserving the latter may be in other respects. I am, Sir, your obedient servant—A CONSTANT READER.

Wonderful! if true.—"*Manchester Police Fire-Establishment.*—This establishment, now undoubtedly the first in the kingdom, as regards efficiency, has just received the accession to its strength of another large, new, and powerful fire-engine, which, as we think very appropriately, has been named the *Niagara.* It is constructed generally upon the same principles as the other engines, and by the same builders; but the suction-pipe has a diameter of four inches, being an inch wider than any of the other engines, and the water ways generally are of greater capacity. These advantages enable the engine to throw through the leather hose, the bore of which is about three inches in diameter, a ton *weight* of water in the short space of one minute, and with the metal jet screwed on, which is 2¼ inches in diameter, the same quantity of water can be thrown in a minute and a half. In one hour, then, forty tons weight of water may be thrown upon a building on fire, from this artificial type of the celebrated falls of Niagara. The last new engine, the *Water Witch*, on the occasion of a fire at Mr. Brignall's premises, notwithstanding the weather was unfavourable, threw water to the height of 126 feet; and it is expected, though in this way no trial of its powers has yet been made, that the *Niagara* will produce a still loftier *jet d'eau.* The number of engines at present in the establishment is only six,—the *Aquarius*, *Vesta*, *Thetis*, *Neptune*, *Water Witch*, and *Niagara*—but they are all of great power, and of more real use than would be thirty engines of inferior capacity and projectile force. In the mail-coach procession on the 1st of May, it is not unlikely that the *Niagara* will first exhibit its *falls* to the gaze of our fellow-townsmen."—*Manchester Guardian, April* 13, 1835.—The writer evidently lies under some unaccountable mistake. A jet of water 2¼ inches in diameter, thrown 126 feet high, supplied by forty tons of water per hour only, is preposterous. A jet ONE INCH in diameter will deliver that quantity in the time.—B.

Lambeth Wrought-Iron Suspension Bridge.—A bill is now in progress through Parliament for the formation of an iron suspension-bridge over the Thames at Lambeth. It is to consist of a principal span in the centre of 450 feet, and two side spans of 225 feet, supported by two columnal piers, each composed of 16 iron cast pillars. The total length of the bridge, including the pillars, will be 940 feet; the height of the middle span 22 feet above the Trinity high-water mark, leaving a clear water-course, for the passage of large vessels, of 410 feet, and nearly the whole width of the river for boats and smaller vessels. Captain Brown, who constructed the Brighton Chain Pier, and other similar structures, is the projector.

The Bude Light is a name given by Mr. Gurney (of steam-carriage abortion celebrity) to a new light which he has discovered, and so named, after his new place of residence in Cornwall. It is obtained by directing a stream of oxy-hydrogen gas on a quantity of pounded egg-shells. The light is represented to be 140 times greater than any of those now employed in lighthouses—so intense, indeed, that Mr. G. lately stated to the House of Commons Committee on Lighthouses, "his belief that it would be possible to make his light, by certain management, point out the precise situation of a coast beacon to a ship three or four miles at sea, under circumstances of a fog so dense that no other light—not even that of the sun—could penetrate it to any distance!"

Steam-Engines in Glasgow.—To such an extent is the business of steam-engine making now carried on here that there are thirteen firms engaged in it. Some of the works are more like national than private undertakings. Three houses alone employ upwards of a thousand persons. Dr. Cleland has ascertained that, in Glasgow and its suburbs, there are thirty-one different kinds of manufactures where steam-engines are used, and that in these, and in the collieries, quarries, and steamboats, there are 355 steam-engines—7,3[illegible] horse power—average power of engines rather more than 20 horses each.—*Ency. Britt.*, 7th edition.

Caoutchouc Whips.—"When H. F., Jun., asserts, that two years since he made whips of a similar construction as those proposed by me, I am bound to believe his assertions; but I firmly affirm, that it was with me purely an original invention, having never received the slightest hint from any one on the subject. If there is, however, any merit in the invention, be it his or mine, I think I am entitled to the merit of being the first to make it known to the world."—E. B.

J. T. Riches. Yes.

J. N. has been anticipated by Lord Dundonald. See Mech. Mag., No. 583.

We do not think it would be of any use to republish Mr. Lunt, of Chester's letter, on the Thames Tunnel, inserted in our Journal of the 28th February, 1829 (No. 290). Mr. Brunel and his friends have now got too fast a hold of the loan from the public purse, to be accessible to argument or remonstrance.

Colonel Macerone's letters are left for him, as requested, with our publisher.

Communications received from J. L.—Mr. Woodhouse—A Florist—J.—Mechanicus—Mr. Andrews—A Sheffield Manufacturer—F. H.—Mr. Henderson—J. W.

The Supplement to our last Volume, containing Titles, Index, &c., with a Portrait, on Steel, of Samuel Clegg, Esq., C. E., is now published, Price *6d.*; also the Volume complete, in boards, Price *8s. 6d.*

Our Publisher will give double price for copies of Nos. 236, 237, 238, 239, 256, 258, and One Shilling and Sixpence each for copies of the Supplement to Vol. X.

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THE CLYDE IRON-WORKS HOT-AIR APPARATUS.

Fig. 1.

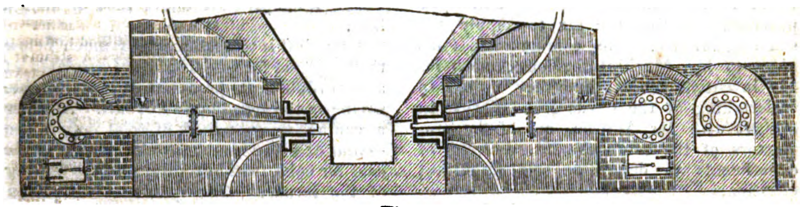
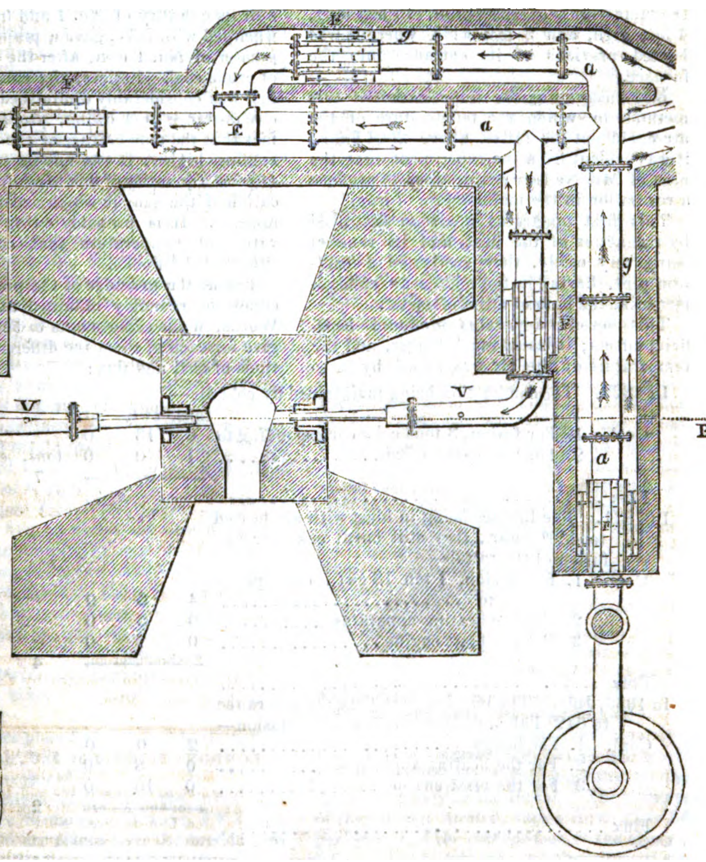


Fig. 2.



3

DESCRIPTION OF THE PROCESS OF USING HEATED AIR, AS ADOPTED AT THE CLYDE IRON-WORKS, BY MESSRS. NEILSON AND CO., THE PATENTEES.

(From Report by M. Dufrenoy, Engineer of Mines to the Directors of Public Roads and Bridges of France, 1834.*)

Some experiments by Mr. Neilson, Director of the Glasgow Gas-Works, led him to think that advantage would be gained by previously heating the air to supply the smelting-furnace. He communicated his ideas to Mr. Mackintosh, long known for his inventive genius, and they united in undertaking at the Clyde Iron-Works, in concert with Mr. Wilson, one of the proprietors of the establishment, a series of experiments to determine this important question.

In the first experiment, the air from the blowing-machine was passed through a rectangular trunk of sheet-iron, 10 feet long, 4 feet high, and 3 feet wide, where it was heated previous to its entrance into the furnace.

Notwithstanding the imperfection of this method, by which the temperature of the air could not be raised above 200° Fahr., it was evident from the experiment that the plan of Mr. Neilson was destined to produce a revolution in the manufacture of iron.

This first apparatus was soon destroyed by the action of the heat, and its renewal being very costly, they sustituted a cast-iron pipe, having in the middle an enlargement like the bulb of a thermometer.

This second apparatus produced beneficial effects; it lasted much longer, and the temperature of the air was raised by it to 280° Fahr. This increase, though small, produced a visible economy in fuel. Messrs. Neilson, Mackintosh, and Wilson, then understood the advantages which would result from raising the temperature many hundred degrees. They abandoned this heating-tube, and constructed a new apparatus, presenting a great number of tubes, heated in many points of their length. By this means the temperature of the air was raised to 612° Fahr., a temperature above that of melted lead.

Though this temperature was much below that required for smelting iron (estimated at about 1500°), it produced a considerable saving in the consumption of fuel. Another advantage was obtained, of great importance—that of being enabled to substitute crude coal for coke, without injury to the walling of the furnace. The quality of the iron was, on the contrary, improved, and the furnace which produced but little more than half its quantity of No. 1 and half of No. 2, when fed with coke, gave a proportion much greater of No. 1 iron, after the substitution of crude coal. Besides, the consumption of fuel was considerably diminished. This last circumstance was owing, probably, to the fact that the temperature of the furnace becoming higher, it was not necessary to add so great a quantity of flux to ensure the vitrification of the gangue which accompanied the mineral. It is probably owing to this elevation of temperature that coal may be substituted for coke.

The better to judge of the progressive increase of economy obtained at the Clyde Works, in the experiments to be noticed, we give for each of them the different consumptions of coal and flux:

	tons.	cwt.	qr.	tons.	cwt.	qr.
In 1829. The combustion being maintained by cold air—						
Coal. 1. For fusion, 3 tons coke corresponding to	6	13	0			
2. For the blast-engine	1	0	0			
				7	13	0
Flux					10	2
In 1831. The furnace being in blast with air heated to 450° Fahr., they still burnt coke for the fusion of the metal—						
Coal. 1. For fusion, 1 ton 18 cwt., corresponding to	4	6	0			
2. For the heating-apparatus	0	5	0			
3. For the blast-engine	0	7	0			
				4	18	0
Flux					9	0
In 1833, July. The temperature of the air was raised to 612° Fahr., and crude coal used for fusion—						
Coal. 1. For fusion	2	0	0			
2. For the heating-apparatus	0	8	0			
3. For the blast-engine	0	10	0			
				2	18	0
Flux					7	0

* For this translation we are indebted to Mr. S. V. Merrick—Franklin Journal for February last.

At this last epoch the employment of heated air had augmented the yield of the furnace more than one-third, and consequently had effected a great saving in labour. In fine, the quantity of air required to maintain combustion in the furnace, was also found to be sensibly diminished. The blast-engine of 70-horse power, which was sufficient in 1829 for only three furnaces, was found of ample power for the blast of four.

By comparing the results which will be indicated, it will be perceived that the economy in combustible is in proportion to the increase of temperature. As to the absolute saving, it varies in each furnace according to the nature of the coal, and the care used in carrying on the operation.

* * * * * * *

The vicinity of Glasgow is one vast coal region, the first in Great Britain, both in the extent and the thickness of the veins. This coal basin is also very remarkable for the abundance of its iron ore, both imbedded in the argillaceous schist of the region, and in regular veins, often of considerable extent.

The layers of coal in the vicinity of Glasgow, which belong to the lower strata of the coal formation, alternate with beds of mountain limestone, so that, in the same locality, are often united the coal, the ore, and flux, and the fire-clay used in the construction of the furnaces.

These invaluable advantages are in part compensated by the enormous loss incident to the carbonisation of the coal in this locality, as well as by the lightness of the coke produced. From these circumstances, a ton of iron requires at the Glasgow Works, for its production, a much larger quantity of fuel than in any district of England.

The employment of the heated air has produced a revolution in the Scotch Works, and enabled them to sustain a competition with those of Wales.

The Clyde Iron-Works were, as before stated, the first in which the heated air was tried. The apparatus now in use (figs. 1 and 2) is composed of a double row of horizontal pipes, *a a a a*, 150 feet long. These pipes are nineteen inches in diameter, and one inch and a half thick. The exterior row passes behind the furnace, and enters the other row, dividing the air into two parts; so that the blast is carried equally to each tuyere.

The valves placed at E regulate the distribution of air, and stop either branch when repairs are required.

In the length of 150 feet, the tubes pass through five furnaces, or heaters, F F F F F, of which two are placed near the tuyeres; so that the air has no time to cool before entering the surface. Figs. 1 and 2 give an exact idea of the form and disposition of the five heating fires; they are connected by a conduit of brick, *g g g*, which envelopes the pipes; by this means the flame which escapes from the fire-place circulates about the pipes, and heats their whole length. To preserve the parts of the pipe immediately in contact with the flame, they are encased in fire-brick the whole length of the furnace. In the first apparatus of this kind which was constructed, the ends of the pipes were inserted one in the other, having some play, to prevent any rupture by expansion; the result was a great loss of air, and the plan was abandoned. Besides, it was remarked that a great waste always took place at the joints of the pipes; so that it was not sufficient to fasten them with bolts and nuts; the joints were therefore covered with a ring of iron cast on after they were finished. By means of this precaution, the pipes lasted a long time; and at the time of my visit they had been five months in use without repairs.

On the exit pipes are made small holes, V V, by means of which any change of temperature in the air might be ascertained. This precaution is indispensable, because one of the essential conditions in the use of heated air is, that its temperature be kept uniform —with this apparatus they raised the air to 612° Fahr., which is higher than the melting point of lead. In the Clyde Works, two of the four furnaces have each an apparatus like the one described, but in the other two there was no room for the extent of pipes, and they are contracted into smaller space, by being doubled upon themselves.

The working of a furnace with heated air, requires no particular precaution; the operation is the same as before its introduction, the only difference consisting in the substitution of raw coal for coke. This substitution did not immediately follow the adoption of the new plan; it was some time after, and only when the temperature of the air was raised above the melting point of lead, that the immense benefit of the change was discovered, giving a consequent diminution in the expense of manufacture.

The general idea adopted in Scotland is, that certain qualities of coal cannot be employed crude, except when the air is highly heated. We have already said that at the Monkland Works, where the air is heated to 460° and 490° Fahr., coke is still used.

The descent of the furnace is very regular—the distances between the charges are nearly equal, the charging being regulated by the space left empty in the throat. The richness of the ore not roasted, varies from 22 to 34 per cent., and the composition of the charges follows this variation. At the time of my

visit, the average yield of ore, after roasting, was 44 per cent., and the charges thus composed:—

660lbs. coal,
520 lbs. ore roasted,
100lbs. lime.

They usually made 40 charges in 24 hours. During the two days that I witnessed the working of the Clyde Works, the number of charges were,

July 4—from 6, A. M., to 6, P. M., 38
from 6, P. M., to 6, A. M., 39
6—from 6, A. M., to 6, P. M., 37
from 6, P. M., to 6, A. M., 40

The yield of the furnace in these four castings was—4 tons, 8 cwt.; 4 tons, 9 cwt.; 4 tons, 6 cwt.; 4 tons, 12 cwt. Total, 17 tons, 15 cwt., for 154 charges,; or, 8 tons 17 cwt. 2 qrs. each 24 hours.

This result shows that a ton of iron is produced at an expense of 2 tons, 8 cwt. 2 qrs. of coal. The consumption of the heating fire is 8 cwt. Total, 2 tons, 16 cwt., 2 qrs. per ton of iron.

The castings are made every twelve hours. The metal obtained is usually a mixture of No. 1, and No. 2. That which goes first from the hearth is No. 1. These two varieties of iron are distinguished by the small channels which furrow the surface of the metal while cooling.

The tuyeres are hermetically closed round with clay, and as they cannot resist the elevated temperature to which they are submitted, water tuyeres have been substituted similar to those used in the fineries. The fig. 3, plate 2, represents the tuyeres employed at the Clyde Works; they are of cast iron, and last various lengths of time, averaging five or six months.

The tuyeres are closed in to prevent the entrance of cold air through the openings. There is no objection to this arrangement, because the air is so hot, that no scoria accumulates upon the pipe, and the workmen are never obliged to free the tuyeres. There is a high white heat in this part of the furnace; nevertheless there are scarcely any sparks produced by the oxidation of the iron, and the particles that fall are black in the centre, showing that the metal is still covered with a small layer of melted scoria.

The flame issuing from the furnace is of a bright red, while that from the coke furnace, worked with cold air, is of a yellowish colour. This difference of colour is as marked as that which exists between the flame of alcohol coloured by strontia and by baryta.

The pressure of the blast in the air-vessel is two pounds and a half, or five inches of mercury to the square inch. It is sensibly the same near the tuyeres, only the gauge which indicates it is subject to great oscillations. This pressure was formerly three pounds. The opening of the tuyere is three inches,—it was two inches and a half when cold air was used. The quantity of air forced into the furnace is less. The blowing engine, of seventy-horse power, served only three furnaces, now it feeds four with ease. From the dimensions of the blowing cylinder* the quantity of wind, which was 2,627 cubic feet per minute of cold air, is now but 2,120 cubic feet.

The furnaces of the Clyde Works have not been altered since the introduction of hot air. They had been in blast a long time when this new plan was adopted; one of them has been seven years in blast, and the regularity of its operations gives an earnest that it will last a long time.

At the commencement of this report, I have already stated the economy of fuel, and of flux, which had been obtained at the Clyde Works, by the introduction of hot air. I think it, nevertheless, useful to show the correctness of the estimate by transcribing a statement of the different expenses of manufacture during a month, while cold air was used, and a corresponding month with the use of hot air.

I make this statement from the books of the Works, to which I have been allowed access with a rare liberality.

Consumption and Produce of Three Furnaces, using cold air and coke, during the month of February, 1829.

	Coke.		Ore.		Flux.		Pig Iron. No. 1.		Pig Iron. No. 2.		Pig Iron. No. 3.		Castings.		Total.	
	Tons.	Cwt.	Tons.	Cwt.	Tons.	Cwt.	Tons.	Cwt.	Tons.	Cwt.	Tons.	Cwt.	Tons.	Cwt.	Tons.	Cwt.
1st week	386	0	227	9	68	2	72	13	32	13	18	13	1	13	125	19
2d do...	411	10	242	11	72	11	51	19	37	11	47	2	0	6	136	19
3d do...	401	0	231	16	70	18	44	16	48	2	38	7	0	3	131	8
4th do...	301	10	177	13	53	6	53	0	27	9	26	3	0	0	105	12
	1500	0	879	9	264	17	222	8	145	15	130	5	2	2	499	11

Add the consumption of the engine, averaging one ton of slack to the ton of iron made.

* The steam-engine which works the blowing apparatus requires for fuel twenty tons of broken coal or slack, per day of twenty-four hours, which costs one shilling and eightpence per ton.

Consumption and Produce of Four Furnaces, using hot air and coal, during the month of February, 1833.

	Crude Coal.		Ore.		Flux.		Pig Iron. No. 1.		Pig Iron. No. 2.		Pig Iron. No. 3.		Castings.	Total.	
	Tons.	*Cwt.*	*Tons.*	*Cwt.*	*Tons.*	*Cwt.*	*Tons.*	*Cwt.*	*Tons.*	*Cwt.*	*Tons.*	*Cwt.*		*Tons.*	*Cwt.*
1st week	510	15	490	7	91	16	81	4	28	15	155	3	..	265	2
2d do.	514	0	491	6	91	7	48	8	46	15	161	18	..	257	1
3d do.	521	15	486	8	91	8	94	12	59	10	109	8	..	264	0
4th do.	470	10	484	12	81	18	75	2	47	10	102	1	..	224	3
	2023	0	1902	13	356	9	299	6	182	10	528	10	..	1010	6

The consumption of the steam-engine averaged 11 cwt. per ton of iron produced.

The result of an examination of these tables is, that for one ton of iron produced, there was consumed as follows:—

1829. *With Cold Air and Coke.*	*Tons.*	*Cwt.*	1833. *Air heated to 612° Fahr. and Crude Coal.*	*Tons.*	*Cwt.*
1. Coal for fusion—					
3 tons of coke corresponding to coal	6	15	Crude coal	2	0
Ditto for steam-engine	1	0	Do. for steam-engine	0	11
			Do. for heating the air	0	8
	7	15		2	19
2. Ore roasted, 3523 lbs. or	1	15	Ore, 3780 lbs, or	1	18
Its average yield being 57 per cent.			Its average yield being 56 per cent.		
3. Flux, 1056 lbs., or	0	10½	Flux, 704 lbs., or	0	7

The daily production of the Furnace was—

11,904 lbs., or about six tons.	18,035 lbs., or about nine tons.

The daily production having been raised at the Clyde Works from six to nine tons, the introduction of hot air has produced an economy in the consumption of fuel, and in the expense of manual labour.

The following table shows the cost of manufacturing pig iron during these two periods:—

	In 1829. Cold Air.					In 1833. Hot Air.				
	Tons.	*Cwt.*	£	*s.*	*d.*	*Tons.*	*Cwt.*	£	*s.*	*d.*
Coal for melting, at 5*s.* per ton	6	13	1	13	3	2	[illegible]	0	10	0
Do. for the blowing machine, at 1*s.* 8*d.* per ton	2	0	0	3	4	0	11	0	0	11
Do. for the heating apparatus	..	..	....			0	8	0	2	2
Mineral roasted, at 12*s.* per ton	1	15	1	1	0	1	18	1	2	9
Flux, at 9*s.* per ton	0	10	0	4	6	0	7	0	3	[illegible]
Labour, at 10*s.* per ton	..	..	0	11	1	..	..	0	6	[illegible]
General expense, interest of capital 6*s.*	..	..	0	6	8	..	..	0	4	[illegible]
Total			3	19	10			2	10	2

[We shall give in our next, from the same source, a notice of the application of the hot air process to other Iron Works in Scotland and England.]

THE UNDULATING RAILWAY—IS THE FRICTION OF ROLLING BODIES ACCORDING TO THE TIMES OR THE SPACES?

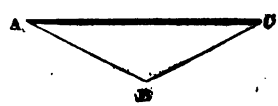
Sir,—Previous to receiving the Number of your Magazine of Saturday last, in which Mr. Badnall appeals to me for an explanation of my opinion, as to whether the friction of rolling bodies is proportional to the times or to the spaces, I had committed to paper the following observations on that point, suggested by the investigations of Mr. R. Stephenson and Mr. Whitehead, and I now, therefore, forward them to you for insertion.

I agree with Iver Maciver that Mr. Stephenson's theoretical investigations, or rather his formulæ, on the undulating railway system, are any thing but satisfactory. I regret, however, that Iver did not go a little more into detail, and treat the subject with a little more *gravity*, than he has thought proper to do. Mr. Stephenson asserts, that if a body be moved from a state of rest upon a horizontal plane, and be acted upon by a continued force d, after passing over a space s, the final velocity acquired will be $\sqrt{2\,d\,s}$. This will, no doubt, be true, if d is a constant force like that of gravity, so as to produce an uniform acceleration of velocity; and if this can be proved to be so in the case of locomotion, produced by steam, it would, certainly, go a great way in diminishing some of the supposed advantages that might be expected from Mr. Badnall's undulating system. For, as Iver Maciver justly remarks, "as s increases, so does $\sqrt{2\,d\,s}$;" so that if the motion be continued for a sufficient length of time, any velocity required is attainable on the horizontal line. But Mr. Stephenson himself, in his practical remarks (No. 602, p. 391,) asserts that this cannot be done. He states—" when the velocity of these engines exceeds that for which they are calculated, the steam acts less forcibly on the pistons, and thus produces an absolute loss of power," &c. How Mr. Stephenson can reconcile this observation with $\sqrt{2\,d\,s}$ being the final velocity obtained on the horizontal line, is somewhat beyond my comprehension. Again, Mr. Stephenson states (p. 389), " the body will arrive at the summit of each undulation with a velocity due to the action of the force d, which is $\sqrt{2\,d\,s}$." Iver has, certainly, mistaken Mr. Stephenson's meaning here; for he (Iver) supposes that Mr. Stephenson meant that $\sqrt{2\,d\,s}$ is the velocity acquired at the point B. But from what follows, it is plain that Mr. Stephenson allows that $\sqrt{2\,d\,s}$ is the velocity the body still retains on arriving at the point C by the undulating line; for, he says, " if the body were actually propelled by the force d, more efficiently on the one surface than on the other, it must arrive at the C with different velocities," &c.

Mr. Stephenson concludes his theoretical investigations with the following incongruous deduction:—

" The above considerations lead me to conclude, that theoretically there is neither advantage nor disadvantage in the use of an undulating surface for a line of railway."

Well, let us try and estimate the precise value of this deduction.



We shall grant Mr. Stephenson, that, when a body is urged on by a force d, (d being considered an uniform force) on the horizontal plane A O C, it will arrive at the point C with the velocity $\sqrt{2\,d\,s}$. We shall also grant, that when the body moves over the undulating line A B C, it arrives at the point C with the same velocity $\sqrt{2\,d\,s}$. But, says Mr. Stephenson, " the velocity given by the force $n\ g$ in descending is lost in ascending." Now, although we should grant that the force $n\ g$ is lost in ascending, still it has produced a certain effect upon the undulating line, which Mr. Stephenson has most unaccountably overlooked, namely, in the element *time*, which, I trust, he will allow is of *some importance*.

Suppose A C is 1 mile, or 5,280 feet; B o=20 feet; and suppose a carriage starts from A, and is urged on by a constant force d, and arrives at C (either on the horizontal line A O C, or the undulating line A B C), with a velocity there obtained of 24 miles per hour, or 35½ feet

per second; then d, expressed in terms of gravity, will be $\frac{(35.2)^2}{2s}$ (s being $=$ 5,280 feet) $=\frac{1239.04}{10560}=.11733$, and $ng=\frac{OB}{AB}g=\frac{32\frac{1}{6}}{132}=.24369$. Therefore, the sum of the two forces $ng+d=.36102=$ P, and the velocity acquired at B will be $\sqrt{Ps}=\sqrt{.36102\times5280}=43.66$: and the time in descending through A B will be $\frac{AB}{43.66}=\frac{5280}{43.66}=120\frac{9}{10}$ seconds. Also, the time in moving up the ascent B C will be $5280\div(43.66+35.2)=66\frac{9}{10}$ seconds $\therefore$ the whole time in the undulating line is $187\frac{4}{5}$ seconds, or 3 minutes $7\frac{4}{5}$ seconds. The time in the horizontal line is exactly 5 minutes; that is, there is a saving of time to the extent of $37\frac{2}{5}$ per cent. gained by the undulating line, and, as Iver Maciver remarks, a like saving of power takes place. Or if we adopt an uniform velocity, which Mr. Stephenson strongly recommends, and suppose the carriage to move over the horizontal line A O C, with an uniform velocity of 24 miles per hour, the time in this case will be 2 minutes 30 seconds. Then, from Iver Maciver's formula, $d+\frac{1}{2}\sqrt{2gsn}$ ($2s$ in this case being $=5280$ feet), is the average velocity from summit to summit, which, being calculated, is 53.13 feet per second $\therefore\frac{5280}{53.13}=99\frac{2}{5}$ seconds is the time in moving over the undulating line A B C; and in this case there is again a saving in time of $34\frac{2}{5}$ per cent. in favour of the undulating line.

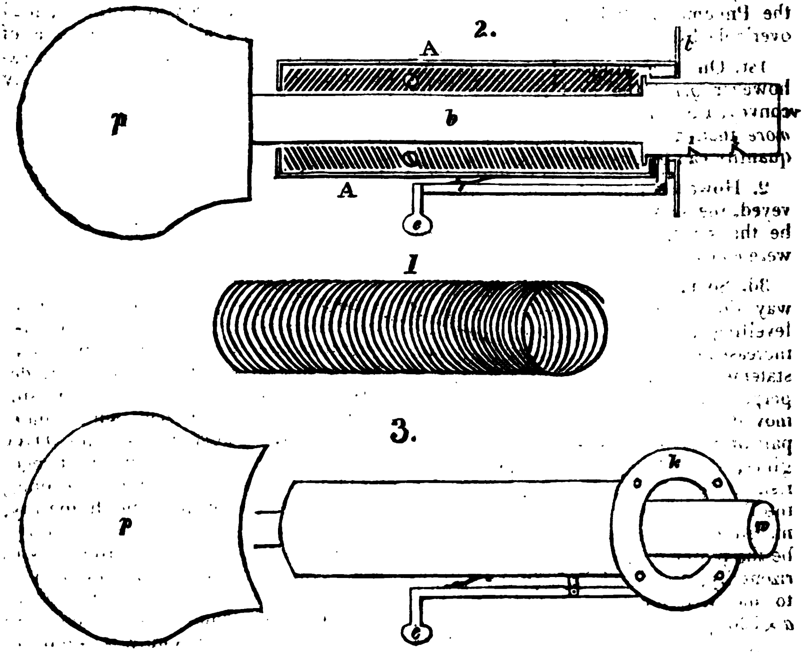
My old friend, the Lieutenant of Engineers, states (No. 597, p. 261,) that he has read Mr. Whitehead's article on the undulating railway question, and that he has every reason to believe that he (Mr. Whitehead) has managed all his equations with skill; still he is afraid the results are not true, because he has founded his solution upon what he conceives to be false principles, viz. that friction is the same at all velocities; while I (Kinclaven) have grounded my calculations on the principle, that friction is proportionate to the times. Your very able Swiss correspondent, Lewis Frend, in the postscript to his article (No. 602,) says, "that if the Lieutenant of Engineers will reconsider what he has said about the principles laid down by Kinclaven and Mr. Whitehead, in their respective solutions of the undulating railway question, he will find that, although differently enunciated, they are fundamentally the same." I must state, that I am of the same opinion with Mr. Frend. For, if friction is proportional to the times—suppose f is the friction for 1 second, then tf is the friction for 6 seconds, and this must be true by hypothesis, whatever the velocity may be; that is, whether the velocity is 10 or 50 miles per hour. Therefore, I must say that Mr. Whitehead was right in saying that friction is the same at all velocities. In fact, if he is wrong, so am I. Mr. Badnall has often stated, that as the velocity increases the friction diminishes; and he is also right in the sense he meant to be understood; that is, when we compare friction with the spaces passed over. Thus, suppose a body moves over a line of 10 miles in 1 hour, and that the whole amount of friction is f, and if the same body moves over a like line of 20 miles in 1 hour, the times being equal, the amount of friction upon the 20 miles will also be f; but if we compare the friction with the spaces passed over, we would say that the friction in the latter case is only one-half of that in the former.

In justice, however, to Mr. White head, I certainly agree with the Lieutenant of Engineers, also with Mentor, that he is an able mathematician, and that in the mathematical part of his article he has shown much skill and ingenuity; although, as Mentor justly observes, there is nothing in that part of his communication which is against the undulating system, or rather the most important part of it—for, so far as time is concerned, it is decidedly in favour of it. But when Mr. Whitehead throws aside the mathematical robe, and assumes that of the special pleader, then, I must say, I cannot agree with him; and more particularly so, when he attempts to show that Mr. Badnall's system in no case offers any inducement for its adoption. So says Mr. Stephenson, in his last deduction; but, if I do not myself labour under some great delusion, I trust that I have proved the contrary.

I am, Sir, yours, &c.

KINCLAVEN.

April 27, 1835.



PERCUSSION-LOCK FOR PISTOL-WHIPS.

Sir,—In your valuable Magazine, No. 598, I perceive an account of a pistol-whip. Of the kind of locks made use of in such cases I am not aware; but I have a percussion-lock that I constructed some time ago that may be used to advantage, and which is constructed on what I take to be rather a novel principle. The following description of it may be, therefore, not unworthy of a place in your widely circulating pages:—

Fig. 1 is a spiral steel spring, 2 inches long, and half an inch in diameter; size of the steel $\frac{1}{8}$ by $\frac{1}{16}$.

Fig. 2 is a section of the lock complete; A A is a copper tube, in which the spring is fixed; *o o* the spring; *b* a bolt that passes through the interior of the spring, the large end of which forms the striker; *f* is the catch, which, when the handle *p* is drawn back, catches into the holes 1 and 2, that form the half cock and full cock; *g* is the spring to the catch.

It will be observed, that when the small nob *e* is pressed upon, the bolt will be freed from the catch, and the part *w* forced against the cap by the main-spring *o o*; *k* is a flanch to screw it on. The large handle, shown in the sketches, is that of a walking-stick, in which the lock is fixed.

Fig. 3 is the lock complete.

I am, Sir,

Your obedient servant,

John Thomas.

Redlake, Wellington, Salop,
March 12, 1835.

A FEW MORE OBJECTIONS TO THE PNEUMATIC RAILWAY.

Sir,—The inventor and approvers of the Pneumatic Railway seem to have overlooked the following objections:—

1st. On the proposed construction, however *great* the load required to be conveyed on the line in a given time, not *more* than a *certain* fixed and constant quantity can by *any* means be conveyed.

2. However *small* the load to be conveyed, the expenditure of power would be the same, as if the maximum load were conveyed.

3d. So far from the Pneumatic Railway doing away with the necessity of levelling the line, the necessity becomes increased fifty-fold. From Dr. Lardner's statements it appears that 1 ton moved perpendicularly will equal 200 tons moved horizontally. Now, if on any part of the line, between two fixed engines, there were an inclined plane, rising, say 1 foot in 10, the capability of the Pneumatic Railway would be diminished to the following extent:—Let a be the power required to move 1 ton horizontally, then $a \times 200 =$ the power to move 1 ton perpendicularly; and $\frac{a \times 200}{10} + a$, the power required to move 1 ton up the supposed inclined plane. Therefore, as the power is constant, if the inclined plane were only 1 foot long, yet only $\frac{1}{21}$ of the load which could be conveyed on a perfect level could be conveyed on the one supposed.

4th. Dr. Lardner states, that if such a degree of rarefaction were produced in the tunnel as would cause the mercury to fall 2 inches, an impulsion equal to 200 tons on a piston of 40 inches diameter would be produced. This is true, but the impulsion would only continue for $\frac{1}{14}$th of the length of the tunnel, when the load would stop. The fact is, the tunnel must be entirely cleared of air to cause the load to move through the whole length; but, according to the data laid down by the Doctor, and which I see no reason to dispute, the area of the section need only be $\frac{1}{14}$th of the size proposed, to move 100 tons along.

Were the tunnel to have a square section, and be enlarged, in those parts of the line in which there is a rise, in proportion to the power required, and the piston were made to expand, the 3d objection would be removed.

It is observable that, if the line had no greater rise in any part than the inclined plane at Rainhill, the expenditure of power would be 230 per cent. of the expenditure required on a line perfectly level.

I am, Sir,

Your obedient servant,

GEO. BERRY.

THE SAFETY-LAMP NOT SAFE.

Sir,—It is a lamentable fact that, year after year, hundreds of those industrious, and it is fair to assume, careful men—the working colliers—are destroyed by the ignition of the inflammable air of coal-mines, while under the alleged protection of the Davy lamp; and that, too, in the best regulated collieries. This fact calls at once, in the name of justice and humanity, for a strict and immediate inquiry. Has the miner, or not, a protection in the lamp to the extent represented by Sir H. Davy? And if its pretensions are founded on false data (which there is but too strong reason to apprehend), is it not high time that the miner should be warned against leaning any longer on a broken staff?

The first point to examine is, what are the pretensions of the lamp? It will not be invidious to refer for information to Sir H. Davy himself, not to some other eminent men, who, since his death, have expressed themselves very strongly on the subject. Sir H. Davy states, in his pamphlet on Flame, p. 41 (a work evidently intended for the working miner's government in the use of the lamp), that, "he has discovered a lamp which will burn in any explosive mixture of fire-damp, the light of which arises from the combustion of the fire damp itself." The instrument to which he here refers is the present Davy lamp. He also states that the miner may work in fire-damp, if protected, as he asserts he is, from its ignition by this lamp. Mr. Buddle, whose authority is indisputable on this point, estimates the value of the Davy lamp, on the supposition that it would enable the miner to work with safety in an

explosive atmosphere. He observes, in a letter addressed to Sir H. Davy, and published by him in the last edition of the work referred to, 1825, "that when the circulating current becomes explosive, only give the collier his Davy lamp, and he goes to his occupation with the same confidence in this impure atmosphere, that he would in any other situation with a candle." Dr. Ure, in his otherwise valuable Dictionary of Chemistry, p. 358, calls this lamp "an infallible protector;" and states, that "no explosive accidents have ever happened in coal-mines since its introduction, but from the criminal daring and carelessness of the miner." Dr. Faraday, even since the late explosion at the Springwell Colliery, when four persons were deprived of life, and many dreadfully injured, spoke of it as "a monument of the powerful genius of Sir H. Davy;" and Professor Brande affirmed, in a recent lecture at the Royal Institution, that he still believed the Davy lamp to be perfectly safe in all its *proper* uses;" which "proper uses" must, of course, be those so plainly pointed out by Sir H. Davy himself.

It will be observed, that neither Sir H. Davy, nor any one of these his intimate and scientific friends, limit the uses of this lamp. They, therefore, sanction the general and fatal error (for such, unhappily, it has proved), that it will enable the miner to remain any indefinite time in an explosive atmosphere. It is true that Dr. Turner informed his readers, in a work he has lately published, but which from its price, and its scientific character, cannot be expected to find its way to the miner's hand, "that if a lamp, with its gauze red-hot (which it soon becomes in an inflammable atmosphere), be exposed to a current of explosive mixture, the flame may possibly pass so rapidly as not to be cooled below the point of ignition, and in that case an accident might occur with a lamp which would be quite safe in a calm atmosphere." Again, he says, "when the lamp is carried into an atmosphere (a calm one) charged with fire-damp, the flame begins to enlarge, and the mixture, if highly explosive, takes fire, as soon as it has passed the gauze, and burns on its inner surface." He properly recommends, that "whenever this appearance is observed, the miner should instantly withdraw; for, though the flame be not able to communicate with the explosive mixture on the outside of the lamp (so long as the texture of the wire-gauze remains entire), yet the heat emitted during the combustion is so great, that the wire-guard, if exposed to it for a few minutes, would suffer oxidation, and fall to pieces;" in which case the terrible event of an explosion must inevitably ensue. Sound and important as this advice is, it happens to be directly opposed to what Sir H. Davy himself has said on the subject, in the pamphlet in question—a striking proof of the great peril to which miners have been exposed, from an implicit reliance on his authority—for, he asserts (p. 135) that "whenever a single wire-gauze lamp is made to burn in a very explosive atmosphere at rest, the heat soon arrives at its maximum, and then diminishes; and the idea of the wire-gauze burning out is shown to be unfounded!"

That Sir H. Davy was greatly mistaken in the safety of his lamp, has been unhappily rendered but too manifest, from the dreadful havoc of life so frequently caused by explosions in those coal-mines, where no other light is admitted. The result of the trials to which the Davy lamp has been lately subjected by Dr. Turner, and which result has been confirmed by the experiments of several eminent, scientific, and practical men, prove that, in an agitated atmosphere of fire-damp, no reliance whatever ought to be placed on its protection; and that even in a calm, the reliance placed on it should be limited to a few moments. As Sir H. Davy's name, in this case, still carries a dangerous authority, and his errors, therefore, require no common efforts on the part of the press to correct them, I submit this letter to your judgment, in the hope that, as it may by possibility be the means of saving human life, you will consider it worthy of insertion in your much read and influential publication.

I am, Sir,

Your constant reader,

U. G. R.

London, May 5, 1835.

Fig. 1.

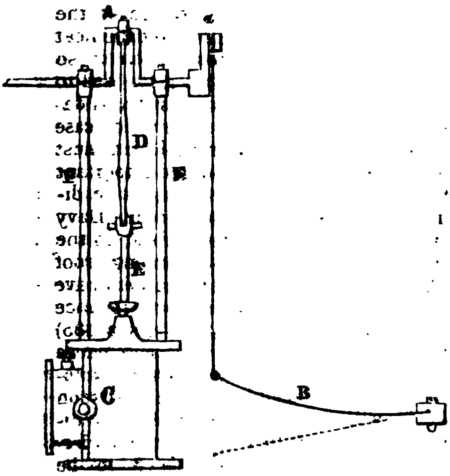
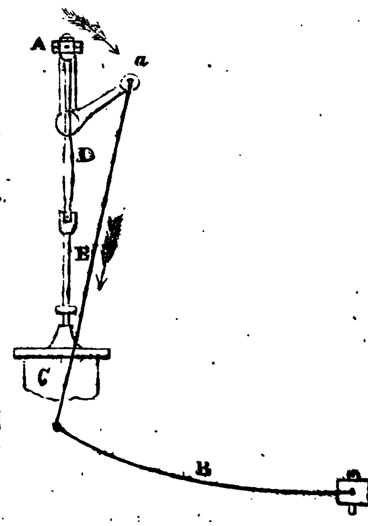


Fig. 2.



METHOD OF COMBINING THE ACTION OF TWO STEAM-CYLINDERS WHEN PASSING THE CENTRE OF REVOLUTION.

Sir,—Having devised a method of combining the mutual action of two steam-engine cylinders in one, when passing the centre, I am desirous that an account of my plan should be inserted in your valuable Magazine. I may first premise, that it is well known, that if a single engine be stopped on the centre (as it is termed), the steam has no power to propel the machine onwards.

The crank A, fig. 1, may (according to circumstances) be either a single one as in the sketch, with another on the end of the shaft, or a double one forged in one piece. When both ends of the shaft are wanted, the crank *a*, instead of being at an angle of 90°, must be only 45°. B is a spring of steel, sufficiently strong to require half the power of the engine to bend it, and firmly screwed to some fixed part of the machine; C the cylinder; D the connecting-rod; E the piston-rod; F supports for the crank, &c.

Fig. 2 is a side view of fig. 1, with the same letters of reference.

Fig. 3.

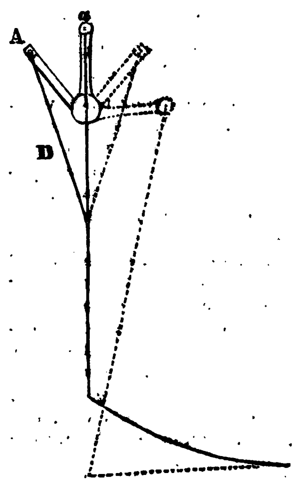


Fig. 4.

Supposing the crank *a*, fig. 3 (which I shall call the spring-crank), is in the position shown in the diagram, and

that the engine-crank A is also re-presented, then the spring-crank *a* is on the centre, and the engine-crank A in action (though with a diminishing force). As soon as *a* is past the centre, it will, by the downward pull of the spring, assist the crank A past its centre, and continue to do so till *a* is in the position shown by the dotted lines, when it becomes passive. The motion being continued by the engine-crank, which is now gaining power, it begins to bend the spring downwards (consequently storing up power), till the cranks are in the position fig. 4. The spring-crank is now just on the point of refunding the power lent it to assist the steam-crank over the lower centre. Thus the steam-crank and the spring-crank *do* mutually help each other, and a pretty regular motion is produced even without a fly-wheel.

The *principle* is here, but the adaptation of it (which admits of innumerable positions of the spring-crank), I leave to the judgment of persons of greater practical acquaintance with the steam-engine.

I beg to subscribe myself, Sir,
Yours respectfully,
MICHAEL NOTON, Jun.

Manchester, Feb. 19, 1835.

THE "SINGULAR HYDRAULIC PHENOMENON" (p. 6).

Sir,—In No. 608 of your truly valuable Journal, Mr. Baddeley has described the effects produced by using a short cylindrical branch pipe with a fire-engine, which were of "so extraordinary a nature as to surprise all the persons who witnessed the phenomenon."

I am convinced that Mr. Baddeley will not be offended, when I assert that nothing which he has there mentioned as taking place ought to be considered as at all "extraordinary" or "singular." It is very possible that I am wrong in this opinion; and if that should be the case, some of your numerous correspondents will, undoubtedly, be kind enough to correct my mistake.

I would ask Mr. Baddeley—what would be the effect produced on a stream of water flowing through a *simple orifice*, without any connexion with a pipe? It is an established fact, that the jet of water issuing through a simple orifice is *contracted*, in a certain degree, in proportion to the extent of that orifice; and what Mr. B. has described as taking place is precisely similar. The opening in the centre of the brass cap may be considered as an orifice not having any connexion with the pipe; the diameter of the pipe is 7-8ths of an inch, and the stream of water was reduced to *nearly* 5-8ths of an inch, which is very nearly the extent of contraction which takes place in a stream of water issuing from a simple orifice. The area of the contracted vein, to the area of the orifice, differs, according to different experimentalists; but the ratio of 1 : .62 is generally taken as the more correct quantity. Now, if Mr. Baddeley will calculate the area of the 7-8th opening, and the area of the jet issuing therefrom—which is said to be something more than 5-8ths—he will find that the result will nearly correspond with the proportion, 1 : .62. The *irregular* surface of the jet was, undoubtedly, similar to the irregularity that exists in the stream issuing from apertures acted on merely by gravity. The reason why the jet appeared to issue 7-8ths of an inch in diameter when the engine began work, evidently arose from there not being sufficient force to make the contraction visible; but when the men got into full work, the pressure was increased to carry the contracted vein to a distance from the opening that made it visible. (Query. Was the pipe in an exact vertical position?)

For me to describe to Mr. Baddeley, and the rest of your readers, the events which exist to produce the *vena contracta*, would be a great piece of presumption; sufficient is it to say, that the contracted vein must always exist as it issues from openings having no connexion with a pipe; and it cannot be of much consequence whether the fluid be acted on by gravity from above, or by artificial pressure from below.

I am, dear Sir,
Very truly yours,
J. J.

Bulbourne, April 25, 1835.

MORE PADDLE-WHEEL REMINISCENCES.

Sir,—I have perused with pleasure "Scrutator's Reminiscences" of the paddle-wheel, an article which I hope,

will be the means of saving your readers the trouble of following out the schemes of the so-called inventors, hosts of whom appear, from time to time, in the Mechanics' Magazine, under the titles of propellers, flappers, propellers, window-blinders, parachuters, duck swimmers, screws, scullers, &c., as it places within one view a good many of the absurd attempts to improve upon the common paddle-wheel. I have also been amused with examining Mr. M'Curdy's propellers, which, though I believe new to that gentleman, were tried by me about six years ago (as already mentioned in the Mechanics' Magazine, No. 582), and were a complete failure, as I afterwards fitted wheels to the boat, which produced much greater speed. The principle was the very same as Mr. M'Curdy's, but I had sixty-two propellers, instead of his four. The objections to them appear to me to be as follows:—1st, The great speed to which they must be driven to make as many strokes as do the blades of the common wheel, and consequent greater amount of friction and weight. 2dly, The propellers, when making their return stroke, in a short head sea or ripple, must just produce as much effect to drive the vessel astern as the immersed ones drive her ahead. 3dly, The great additional breadth necessary, as Mr. M'Curdy's wheel is twelve feet broad, if his cranks have a three feet throw. (It is to be regretted there is no scale attached to the engraving.) 4thly, It would require a very heavy shaft, with so many cranks on it, as shown in Mr. M.'s sketch, and even with great additional strength and weight, it would be a most unsafe thing at sea in bad weather.

Let us examine what speed, for instance, it would be necessary for Mr. M'Curdy's anti-propeller, in such a boat as the Forth, which steams between Dundee and London. That vessel's wheel is about 50 feet in circumference, and makes 20 turns per minute to produce 12 miles an hour; now, suppose the wheel to have 12 float-boards, 6 feet broad (a circumstance I am not sure of, but I have stated it within the mark); thus we have 240 strokes or immersions of the blades per minute. To produce the same effect with the "propellers," the breadth would have to be 24 feet (instead of six); and as each revolution only produces four immersions, it would necessarily require 60 revolutions per minute (instead of 20); a rate of motion, with such a weighty machine, which is impracticable—to say nothing of the additional breadth of 18 feet in each wheel, and the retrograding effects of the back strokes already mentioned.

The superiority of the common wheel seems to consist in its extreme simplicity, and the facility with which it can be driven at a great speed. In whatever way, too, a wave strikes it, or however much the vessel pitches or rolls, every time it touches the water it urges the vessel forward. It is evident, in theory, that the wheel has some disadvantages; but theory and practice do not always agree, and in this case it is undeniable; for, of the immense number of *inventions*, not one has ever come up to the wheel. And it would now seem that improvements on the wheel itself are likely to be attended with favourable results. I trust these remarks will be thought worthy of a corner in your pages; they are not meant as a critique upon Mr. M'Curdy's *invention*, but simply to impress upon the minds of *inventors* the necessity of making a few simple calculations, and looking over the Mechanics' Magazine, to see that nothing of the same kind has been already invented.

I am, Sir,
Your most obedient servant,
D. Landale.

Wemyss Cottage, April 15, 1835.

THE "HYDRO-PNEUMATIC PUMP," A FALLACY (p. 41).

Sir,—The hydro-pneumatic pump of your correspondent W H O, described at p. 41 of your present volume, would induce the belief, that the inventor's acquaintance with "the laws of fluids," to which he refers, is but very slight. His *simple* apparatus might be extensively useful, but for one or two unfortunate circumstances which prevent its action.

In consequence of a *law of nature*, which has not been, and is not likely to be repealed, the opening of the exit pipe M (p. 41), must be at least THIRTY FEET below the cylinder A, or the water will not flow out of it! I fancy this would put a new feature upon W H O's invention, and render the machine ex-

tremely unwieldy and inconvenient; indeed, far more so than its inventor seems to have imagined.

But even if the exit-pipe were prolonged to the required depth, "*an almost perfect vacuum*" could not be obtained; the quantity of vapour and atmospheric air given out by water being so great as to prevent the formation of a vacuum.

By reference to any treatise on pneumatics, WHO will perceive that the case stands as I have represented it; and that, if he were to construct a hydro pneumatic pump, agreeably to his description, that would stand too.

I am, Sir,

Yours respectfully,

William Baddeley.

London, April 20, 1835.

ON SECURING VESSELS AGAINST THE EFFECTS OF VIOLENT CONCUSSIONS.

Sir,—The plan of your correspondent, Mr. Aldersey (p. 477 of your last volume), tending as it does to promote the safety and preservation of individuals, under circumstances the most appalling, might, I should consider, be carried to a much greater extent of usefulness than merely applying it to the purposes of steam-navigation. I would, with deference, suggest, that it would also be applicable to sailing-vessels generally. The ingenious design of Mr. Ralph Watson, for preserving ships from foundering by means of copper tubes, is already too well known to need remark, and nothing but the great expense attendant upon the application of the scheme, could have stood in the way of its general application. With a view, then, of rendering the plan of your correspondent of more general service, I would propose that the centre-hold and midships of every vessel be coppered internally, i. e. between the ribs and inner lining, and that it should have bulk-heads proportionately strong, and lined in a similar way, to meet the resistance which, in case of accident, the pressure of water would require. As respects cargo, iron, and materials of a like nature, might be stowed in those parts of less consequence, and the better goods be preserved in the portion secured as before described. Circumstances might require the bulk-heads to be partially removed, in which case convenient ports might be left at various places, and secured previously to leaving port; and for a gangway between decks, a sliding or sliding-doors might be so arranged and constructed, that on being closed, in case of emergency, they would be nearly water-tight.

By adopting such precautions numerous advantages would necessarily result—1st, the safety of lives; 2d, the safety of property; 3d, less uncertainty of commercial communication; 4th, reduced insurance, &c.

The difficulties attendant on their adoption would be such only, as would be more than compensated for, the first time the vessel sprung a leak at sea, or encountered more severe injuries nearer home.

I remain, Sir,

Yours respectfully,

James Woodhouse.

Kilburn, April 23, 1835.

ROTARY STEAM-ENGINE APPLIED TO RAILROAD TRANSPORT.

(From the American Railroad Journal of March 28.)

We were much gratified, yesterday, with an excursion to Newark, on the railroad, the cars being drawn a part of the way by Mr. Avery's rotary engine. This is the first, and we are highly gratified to know that it has proved an entirely successful application, of this ingenious, yet exceedingly simple engine, to railroad uses. Mr. Avery had, for near two years, one of these engines in successful operation in his machine shop at Syracuse—which proved to his entire satisfaction that it might be applied to other purposes; and, with a perseverance worthy of the success which has crowned his efforts, he has devoted himself to the construction of a locomotive engine, which is now in use on the Newark railroad, performing that part of the route only between the Hackensack and Newark. There being no revolving platform at Jersey city, it does not yet run through the whole line.

Mr. Avery is unfortunate in the road on which he makes his first trial. A straight and smooth road is necessary in order to attain a high velocity; but the Newark road, unfinished as it is, and in some places more or less affected by frost, with one or two very short curves, will not admit of the speed which this engine is capable of attaining. On returning from Newark, however, we noted the time of starting from the east

side of the Passaic bridge—where the engine was stopped, in consequence of having parted the fast by which it was connected with the car—and of arriving at the revolving platform within a few rods of the Hackensack, called four and a half to five miles, which distance was performed in a fraction less than eleven minutes.

This engine is an *experiment only*. It is the first and *only* effort to apply it to such purposes, and under all the disadvantages of poor wood, and a road much in want of adjustment, it may be considered as a highly successful experiment.

When Mr. Avery shall have completed another and more powerful engine, which he has now in course of construction, designed to test the principle more effectually on a more perfect road, we doubt not his attaining a *greater* velocity than has ever yet been attained in *this* country—or even in Europe—we shall probably be deemed "rotary engine mad," when forty miles per hour is named as not of difficult attainment.

With true Yankee enterprise, Mr. Avery and his associate, Captain Lynde, are determined to carry the war into the enemy's camp, by taking one of their engines, complete and ready for use, to England.

Subjoined is a short account of the performance of one of the small-sized engines built by Mr. Avery, which we obtained when on a visit to Syracuse last fall, and saw the whole in operation.

The engine, that is, the shaft and arms, weigh, as we learn, only 15 lbs.; the arms, from centre of shaft to their ends, are 18 inches, and in their revolutions describe a circle of 9 feet 5 inches in circumference; the two apertures at the end of the arms are equal to the eighth part of a superficial inch, and under a pressure of 80 lbs. to the square inch, will balance a weight of 10 lbs. From some experiments made, it is estimated to carry a load of 8 lbs. through a space of 37,066 feet per minute. The boiler has 69 feet surface exposed to the fire, and consumes daily half a cord of soft dry wood.

There is in the establishment the following machines in operation, viz.:—2 large engine lathes; 2 small do. do.; 2 hand lathes; 1 boring mill for boring cylinders; 2 drilling lathes; 1 grindstone; 1 mill for grinding coal; 2 bellows, 40 double strokes each per minute, which will force 580 cubic feet of air per minute, under a pressure of 1½ lb. per square inch.

The engine had been in operation about 18 months, during which period it did not stop one hour in consequence of the operating part being out of order.

ILLUMINATION OF THE NAMES OF STREETS.

Sir,—I hope that you will favour me by inserting this short letter in your valuable Journal. From the facility with which the hour of the night is observed in many places, through the medium of illuminated clocks, it has occurred to me, that were the names of the streets painted in black upon the lamps, at the corner of every street, they would not only be more visible in the dark, but at all times catch the eye more readily. In many instances it is utterly impossible to read the names of the streets when the lamps are lighted, and sometimes very difficult even in the day-time. The method I propose would also be more durable, and less expensive, than the present one.

I am, Sir,
Your humble servant,
R. RICHARDSON.

May 2, 1835.

NOTES AND NOTICES.

Railways in India.—Canals must depend for their utility upon a regular supply of water; and in many parts of India it might be difficult to secure it. In such circumstances railways present an admirable substitute. Even where the difficulty of obtaining water was not great, railways might be preferable in cases where the probable amount of traffic was limited. The expense of such works would be far less than in England. In our country an enormous proportion of the expense varying from a third to a half, arises from the purchases of land, fencings, parliamentary and law proceedings, and other causes independent of the mere construction of the railway. In India some of these charges might be avoided altogether, and others would be very much reduced. The actual expense of the work would also be less than that of similar undertakings in England. As the traffic would be comparatively small, a single road, with occasional passing places, would be sufficient; and as the weight of the carriages and lading would be much less, the rails might be proportionably lighter. Labour in India is vastly cheaper than in England; and, under these circumstances, the cost of railways would be extremely moderate. At present, perhaps, the use of animal power would be the most advantageous; but this, of course, would form one point of inquiry with those who might be disposed to undertake such works. There are various lines upon which railways would be immediately profitable; and if the resources of India should be improved to the full amount of their capabilities, a necessity for fresh lines would be created, whilst the old ones would become increasingly lucrative.—*Thornton's India.*

Bacon's Notions of Light.—Among the fortunate conjectures which have been confirmed by subsequent experience, that of Bacon is not the least remarkable. "It produces in me," says the restorer of true philosophy, "a doubt whether the face of the serene and starry heavens be seen at the instant it really exists, or not till some time later; and whether there be not, with respect to the heavenly bodies, a true time and an apparent time, no less than a true place and an apparent place, as astronomers say, on account of the parallax. For it seems incredible that the species of rays of the celestial bodies can pass through the immense interval between them and us in an instant, or that they do not even require some considerable portion of time."

Reynolds' Rotary Steam-Engine.—An engine on this principle has lately been invented by John Reynolds, Esq., of Pontrhydyven, in this county, which is calculated for great power in a comparatively small compass, and, in all probability, will supersede the reciprocating engine, either for locomotive or marine purposes. One of twenty-horse power has lately been constructed, by way of experiment. It is similar in form to the Earl of Dundonald's engine; and although the experimental one was imperfectly packed and bored, yet it

worked with six per cent friction, and making 60 revolutions in a minute, with a pressure of 50 lbs. upon the inch. There is one now in course of manufacture, and the first trial of its capabilities will be on the Manchester and Liverpool Railway; it is expected to be ready in about two months; the friction of which will not exceed three or four per cent.—*The Cambrian.*

Mammoth Press.—We saw yesterday in operation, at the printing-office of Mr. Jared W. Bell, a single cylinder Napier press, made by Hoe and Co., which we take to be the largest in the world. The cylinder is 60 inches by 40. The press cost 4,000 dollars.—*New York Evening Star.*

Magnetising Power of the Solar Rays.—The more refrangible rays of light—that is, all save the yellow, orange, and red—have been said to possess the property of rendering iron and steel magnetic. The existence of this property was first asserted by Dr. Morichini, of Rome, and was supposed to be afterwards incontrovertibly established by some experiments of our learned and accomplished countrywoman, Mrs. Somerville, who stated that she rendered sewing needles magnetic by exposure for two hours to the violet ray. Messrs. Reiss and Moser, however, on repeating the same experiments, found that the oscillation of needles was not the least affected by any degree of exposure to the prismatic colours; and hence they have been led to infer that the means employed by Mrs. S. for ascertaining the magnetic state of the needles could not have been sufficiently exact. Another series of experiments, which have been more recently made, with great accuracy and care, by Mr. John W. Draper, of Christianville, Virginia (Frank. Jour. vol. xv. p. 79), negative the existence of the magnetic property still more decidedly. Mr. Draper, indeed, goes so far as to contend that "the magnetic action of a ray of the sun, or any other star, is a physical impossibility." "We usually consider," he says, "a ray of light to consist of a vast number of particles of excessive smallness, but nevertheless of absolute size, which move with an immense but measurable velocity." And he proceeds to show that "these particles are non-conductors of electricity—the best non-conductors, perhaps, of any thing we know."

New Mechanical Power.—We are requested by Mr. Galt to intimate, that he is desirous of giving to the ingenious, as well as to regular civil engineers, ocular demonstration of the existence of a local mechanical power, which is produced by a combination of the natural forces which govern solids and fluids—is capable of incalculable application, being only limited by the quantities of the land and the ocean—is as simple as the rope and pulley—and, scientifically speaking, is applicable to the raising of any fluids from any depth to any height. —*Greenock Advertiser.*

Steam-Boat Explosion.—The opening of the steam-boat navigation on the western waters, for the present season, has already been marked by the occurrence of an explosion and loss of lives. The *Cincinatti Republican* states that the Cavalier, Capt. Thompson, burst one of her boilers on her passage from New Orleans up the Mississipi, about one hundred miles below the mouth of the Ohio, where she now lies. Several persons were injured, and, we learn, two killed. "Nothing short of the enactment of a law by Congress, with the strictest regulations and the heaviest penalties, can effectually prevent the risk and loss of life and property to which steam-vessels appear to be especially subject in that part of the country."—*Baltimore American.*

Statistics Extraordinary.—There is iron enough in the blood of forty-two men to make a ploughshare weighing twenty-four pounds. The quantity of *brass* in their faces it is not so easy to calculate. —*Buffalo Paper.*

London and Birmingham Steam-Carriage Company.—A special meeting of the shareholders of this company was held on Monday, at Birmingham. The Report of the Directors, which was of considerable length, entered fully into particulars connected with the difficulties to which the invention has been subject, all of which it states to have been overcome, and that the undertaking is now brought to a point at which it may be safely taken up and prosecuted with energy. The Directors add, that they are not aware that a single defect now exists worthy of notice; and are satisfied that the difficulties in the way of running steam-carriages on gravel roads are entirely obviated.—*Birmingham Gazette.*—*Nous verrons.* This is, we believe, Dr. Church's Company.

The Pneumatic Railway.—We have received a very intemperate reply from Mr. Pinkus to our strictures on his "National Pneumatic Railway Association" scheme, accompanied by as intemperate a letter, in which he peremptorily "demands," as a matter of "right," that it shall be inserted in this our present Number. We do not recognise Mr. Pinkus's claim of "right;" and though we mean to insert his reply, we shall do so at our convenience. Had Mr. Pinkus shown, by his reply, that we had misrepresented his scheme in a single particular, we should (as our practice is in such cases) have published it immediately; but it does nothing of the kind. The truth is, that Mr. Pinkus has been very leniently dealt with; and that if we have erred at all, it has been in doing but half justice to the prodigiousness of his ignorance and presumption.

Mr. Barlow's Railway-Bar Experiments.—We shall, in consequence of what Philo-Stephenson states, examine a little more carefully the nature of the experiments which have led Mr. Barlow to decide in favour of the parallel-rail; but if he will refer again to our notice of Mr. Barlow's pamphlet, he will see that we took it for granted that the experiments were in every respect unexceptionable.

"L.'s communication" shall have a place soon.

Mr. Badnall's revised reply to Mr. R. Stephenson, Jun., and Mr. Whitehead, in our next.

Communications received from Mr. Quantrille—M. N.—Mr. Matthews—J. N.—Mr. Peacock—Anti-Cricket—R. E. V.

The Supplement to our last Volume, containing Titles, Index, &c., with a Portrait, on Steel, of Samuel Clegg, Esq., C. E., is now published, Price 6*d.*; also the Volume complete, in boards, Price 8*s.* 6*d.*

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FOX'S DIPPING-NEEDLE DEFLECTOR.

Fig. 1.

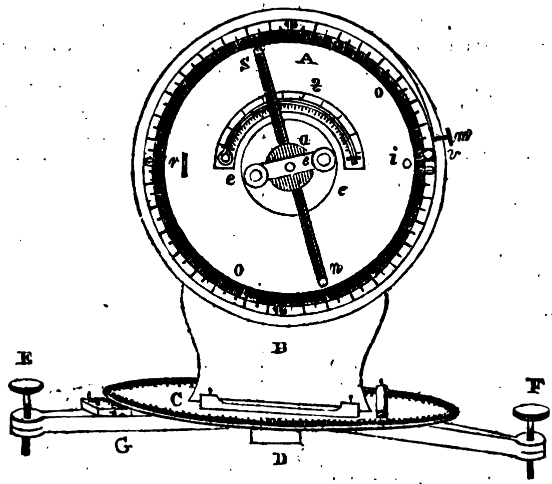


Fig. 2.

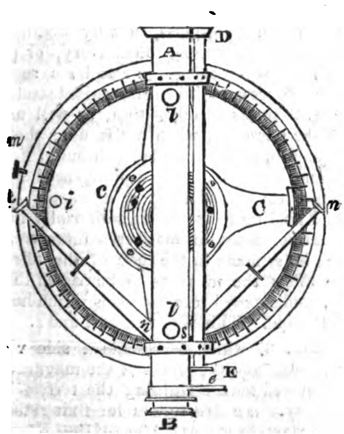
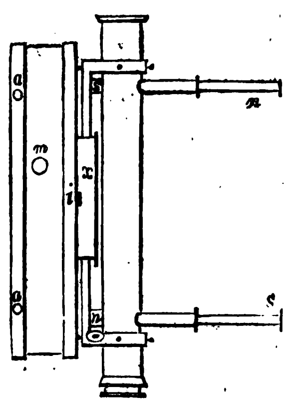


Fig. 4.

Fig. 3.



FOX'S DIPPING-NEEDLE DEFLECTOR.

At the meeting of the British Association, held at Oxford, in June, 1832, R. W. Fox, Esq., of Cornwall, showed to several scientific gentlemen present a very ingenious instrument, which he had contrived for ascertaining the comparative intensity of the terrestrial magnetism in different latitudes and longitudes. Since then Mr. Fox has had a larger instrument on the same principle constructed, with which some observations have been made in different parts of England and Scotland, that have, we understand, proved extremely satisfactory. This instrument was exhibited at the last Annual Exhibition (the second) of the Cornwall Polytechnic Society; and a description of it, illustrated by engravings, is annexed to the Report made by the Committee of that excellent Institution, of its proceedings during 1834, from which Report we now take leave to transfer it to our own pages. It is stated, in a note to the Report, that "the lines of equal dip and equal intensity appear, from the observations which have been made, very nearly to coincide with each other, passing obliquely through the kingdom from E. S. E. to W. S. W. The dip at Falmouth, as indicated by the instrument, is 69° 43′, variation at ditto, 25.4° W."

Description.

Fig. 1, A is a cylindrical brass box, fixed in a vertical position on the stem B, and horizontal circular plate C; all of which can be turned round together, in any direction, on their common axis at D, which is ground into the centre of a tripod, two legs of which, furnished with adjusting screws, are shown at E and F. G represents a nonius and tangential screw, fixed to a leg of the tripod, to subdivide the graduated circle near the circumference of the circular plate C; which is furnished with levels at right angles to each other, for the purpose of adjustment. The needle *n s*, having a small grooved wheel *a*, fixed on its axis, is supported by the concentric disc *c*, and a bracket *e* attached to the disc; perforated jewel holes being inserted in both of them, to support the axis of the needle, which, as well as the pivots, are exactly similar to those made for chronometers. The concentric disc is accurately fixed into the back of the box, and may be turned round with the bracket on its axis by means of knobs at its back, which are shown in fig. 2. This contrivance admits of the bracket being moved round to any convenient position, so as not to interfere with the dip of the needle in any latitude.

The socket *v*, fixed to a brass spring, is intended to confine the end of the needle, when not in use; it being pressed forward by the screw *m*. There are two parallel graduated rings, one of which is a little within the outer surface of the dipping-needle, &c., shown at *o o*; the other ring is immediately under the glass, its object being to direct the sight, and to enable the observer to subdivide the degrees on the inner circle. It is supposed to be removed in the figure. *t* is a thermometer.

Fig. 2 represents the back of the dipping-needle box. *y* is the back of the moveable central disc, which is grooved for the purpose of producing a vibration of the needle, by drawing a brass rod over its surface; by which means, the needle is enabled to overcome any friction of the pivots, and to assume its true direction in a very satisfactory manner. A B is a telescope, provided with cross wires, and firmly fixed to arms, and a concentric ring *c*, which is ground on to another concentric ring, attached to the back of the instrument, and furnished with a flanch: this admits of the telescope being moved in a vertical plane in any direction. The arm C, at right angles to the telescope, is provided with a nonius to subdivide the graduated circle shown on the back of the box. D E is a small tube for solar observations, fixed parallel to the telescope. This tube is furnished with a convex glass at D, the focal distance of which is rather longer than the tube; and at E there is a plane glass, with a very small circular spot on it, which forms, with the concentrated light of the magnifying-glass, a very distinct and bright annular image on an ivory, or plaster of Paris surface at *e*. *n s* and *s n* represent brass tubes containing magnetised steel bars.* Fig. 2 shows their position, as well as that of the telescope, when not in use; the *n* and *s* poles of the magnet being brought near the *s* and *n* poles of the dipping-needle in the box; thus producing a magnetic circuit, and tending to insure an uniformity in their relative states of magnetic intensity. *l l* are holes made in the tube of the telescope, to allow the magnets to be passed through it, and screwed into the arms which hold the telescope. This is shown at *n* and *s*.

Fig. 3, which represents a side view of the box, and the places of the magnet, when employed for ascertaining the terrestrial intensity. *a a* are screws for fixing the ring and glass cover over the face of the instrument.

* Bars made of loadstone may be substituted, if preferred.

Fig. 4 represents a grooved wheel, fixed on the axis of the needle *a* (fig. 1), with a fine silk thread, having hooks at each end, passing over the wheel in the groove.

USE OF THE INSTRUMENT.

To observe the magnetic variation.

1. Ascertain the true meridian by any of the usual methods; the small tube being used for solar observations, and the telescope for observations at night. Note the angle cut by the nonius on the circular plate C. If the plate be turned round 90° from that point, the face of the instrument, or rather the plane in which the needle moves, being parallel to that of the tubes, will be at right angles to the plane of the true meridian. The deflecting tubes *n s* having been removed from the back, turn the instrument round *gradually*, so that the needle may become *perfectly vertical* after vibration, friction having been employed several times at the back of the disc *y*, fig. 2. The face of the instrument will then be at right angles to the plane of the magnetic meridian; and the angle described on the circular plate will give the variation from the true meridian. The face of the instrument should, however, always be turned round to the opposite quarter, till the needle again becomes vertical, which will either confirm or correct the preceding experiment, by taking half the difference between the two observations.

To ascertain the dip.

2. The face of the instrument having been made to coincide with the *plane* of the magnetic meridian; suppose it to be at first turned toward the east; note the exact dip at *both* ends of the needle after vibration, as before described (this precaution should in every case be carefully attended to, and repeated several times); then turn the face towards the west, placing it in the same plane, and observe and note as before: the mean of these observations will give the dip.

To correct the observed dip.

3. The instrument being still in the magnetic plane, and fixed in that position by means of the lever or clamp, connected with the nonius; screw on one of the deflectors *n s* at right angles to the tube, as shown in fig. 3, so as to repel or deflect the end of the needle which is nearest to it; then, if the observed dip was 69° 45′, move the deflector a certain number of degrees from 69° 45′, as shown by the nonius *c*; say 50° to the right of the dip, when the needle will be repelled in the opposite direction: suppose the mean angle at *both* poles of the needle, after frequent vibrations, to be .... 54° 33′

Then move the tube 50° to the left of the dip, when the needle will be repelled in the contrary direction: suppose it to stand at .... 84° 47′

Mean .. 69° 40′

If the face of the instrument, whilst making these observations, should be towards the east, turn it round towards the west, adjusting it in the same plane, and repeat the observations; if the mean result should be ..... 69° 46′

The mean or corrected dip will be .... 69° 43′

Similar observations may be multiplied at pleasure, by varying the angles of the deflector from the observed dip; and by thus taking the mean of many observations, the true dip may be obtained with a great degree of precision.

To find the relative intensity of the terrestrial magnetism.

4. The instrument being still in the plane of the magnetic meridian, screw the deflectors (or one of them) into the arms at the back of the instrument, as shown in fig. 3, and cause the latter to coincide with the direction of the dip, when the needle will be repelled from it: mark the angle to which the needle points at both ends (after repeated vibrations as before described), then cause the needle to swing back to the other side of the dip (one of the deflectors being temporarily removed for this purpose), and note its place as before: half the sum of the angles to which the needle is thus deflected (or rather of their sines), will represent the relative force of the terrestrial magnetism, at different places, on a needle thus circumstanced. It is desirable that the observations should be made with the face of the instrument turned towards the east, as well as towards the west; and likewise only one deflector may be used as well as both of them, in order to vary and multiply the observations for the purpose of correction.

If the angle of deflection at a second place of observation should be greater or less than at the first, the force of the earth's magnetism will be inferior or superior to the latter, as represented by the different angles.

5. The amount of any such difference may, when required, be represented by weights. For this purpose the glass, which protects the face of the instrument, should

be removed, and the silk thread placed on the grooved wheel, as shown in fig. 4. The minute weights required to be suspended to one of the hooks, in order to bring the needle to some given angle from the actual dip, will indicate the relative magnetic intensity at different stations. Suppose, for example, that at a given place the observed dip is 70°, and that at a second place, in a lower latitude, it is 45°; adjust the deflectors, as before described (4), so as to coincide with the dip of the needle at the place of observation, whatever it may be; assume that the needle is repelled 70° from the dip of 70° at the first station, and 80° from the dip of 45° at the second station; it will show that the terrestrial magnetic intensity is greater at the former than at the latter. The weights required to be suspended to one of the hooks, in order to bring the needle to its original position of 70° from the dip (if that be taken as the standard), will indicate the difference of intensity. Thus, for instance, if five-tenths of a grain be required to bring the needle from the angular distance of 80° to that of 70°, from the dip at the second station, this weight will indicate the *difference* of the magnetic intensity of the earth at the *two* stations, acting on the needle in question, when at an angle of 70° from the natural dip.

6. The ratio of this difference, to the whole force of the terrestrial magnetism so acting, may be ascertained, by moving the deflectors to the angle of 70° from the dip (because the needle is assumed to have been deflected to this angle at the first station), the needle will then be repelled to the opposite side of the dip, and the weight required to counteract the deflection sufficiently, to bring it back to the dip, will represent the whole influence of the earth's magnetism, at the first station on the needle, whilst at the angle of 70° from the dip. This will be evident, when it is considered that the angle between the needle and deflectors is in both instances the same; it being coerced, contrary to the repelling force of the deflectors in one case by the earth's magnetism, and in the other by the weights, to the *dip or line of quiescence*. The earth's magnetic force acting on the needle so deflected, and the weights will, therefore, be equal to each other. If 3.34 grains be the weights required, and five-tenths of a grain equal the difference between the two stations, the terrestrial magnetic intensity will be in the ratio of $3.34 - .5 = 2.84$ at the second station, to 3.34 at the first station.

From the observations which have been already made with the dipping-needle deflector, furnished with a needle less than six inches long, there is good reason to believe that it will clearly indicate a difference of intensity at places situated at less than one-half a degree of latitude from each other.

7. Observations on the magnetic intensity and dip may likewise be made *without the deflectors*, by means of the weights only, suspended from the silk thread shown in fig. 4. This method is too obvious to require a minute description, the weights in this case being used to produce deflection from the dip at any place, instead of the magnetic deflectors:—the weights required to cause a given amount of deflection being taken as the relative measure of the magnetic intensity at the place of observation: thus, in the case before supposed, 3.34 grains would produce a mean deflection of 70° from the dip at the first station; and only 2.84 grains would do so at the second station.

To detect the amount of any alteration in the reciprocal force of the needle and deflector.

8. This object will be accomplished by the observations already described; or the deflector may be placed at any other given angle than 70° from the actual dip at the place of observation, so as to repel the needle from the dip, when the weight required to bring the needle back to it will be a constant quantity in all latitudes, other circumstances being the same; and if there should be any change in the reciprocal action of the needle and deflectors, its amount and ratio to the whole force will be shown.

There are other methods of attaining this object, which it is unnecessary here to describe, as this appears to be as simple and satisfactory as any.

To ascertain if there be any alteration in the force of the needle only.

9. Remove the small screw from the back of the instrument, and replace it by another, furnished at its extremity with a minute cylinder of soft iron; the opposite poles of the needle may then, in succession, be allowed to adhere to this iron, and be separated from it by weights suspended from holes in its arms, equidistant from its centre. The weights required, will indicate the magnetic force of the needle, and detect any change, if it should have taken place; this, however, is not likely to occur to any considerable extent, at least, if the needle should have been long magnetised.

Temperature.

10. The temperature indicated by the thermometer *t*, fig. 1, should always be noted, when observations are made on the magnetic intensity; and if the temperature be found very different at any two places, a correction should be applied. The amount of this may be easily ascertained, by previous experiments with any given instruments. In the

one now described, a deflection of the needle at the angular distance of 72° from the dip, at the temperature of 60° was *diminished* only 22′, when the temperature was raised to 105°: indicating a diminution of 1′ in the angle of deflection, caused by an increase of 2° of temperature.

To arrange the instrument for packing.

11. Adjust the telescope and deflectors as in fig. 2, the latter being firmly screwed into their sockets, and care being taken that the *s* pole of one deflector be opposite to the *n* pole of the needle, and *vice versâ,* as it respects the other. In fig. 2, the North pole of the needle is supposed to be fixed by the socket and spring (represented at *v*, fig. 1), which are pressed forward by the screw *m*. The bracket *r*, fig. 1, may be pushed forward, so as to hold the other arm of the needle; and the nonius clamp should also be tightened, when the instrument is placed in its box, to prevent vibration. If these precautions are attended to, the instrument may be sent to any part of the world, without risk of receiving injury.

12. The general description here given of the *dipping-needle deflector*, may be sufficient to explain the methods of using it, and the purposes to which it may be applied; but it requires some practice to employ it with the best effect. This remark is particularly applicable to the accurate observation of the place of the needle at each of its extremities, the outer graduated circle being in all cases used for directing the sight:—and it equally applies to the mode of producing friction with a small brass rod, or large wire, on the grooved disc *y*, fig. 2. The friction should be rapid, and gradually diminished in force; and it ought to be repeated several times, the position of the needle being observed at each interval.

When the operation is properly managed, its effects on the needle are remarkably uniform and satisfactory,—obviating any objections which might otherwise be made on account of the friction of the pivots. The instrument is very portable, and the mode of keeping up the magnetic influence between the needle and deflectors, when not in use, affords great security from any danger of their forces being deranged by external causes.—Possibly, as has been suggested, the loadstone might be used with advantage for deflectors, instead of the steel magnets; but there is every reason to believe, that after a time the force of the latter will not be liable to any change. It should have been before observed, that the magnetic deflectors are placed, when in use, at right angles to the plane of the dipping-needle, and consequently to the direction of the earth's magnetism, which therefore exercises no adventitious influence upon them. It is also evident, that the instrument may, when required, be used as a *theodolite*, it being, in like manner, provided with a triangular stand.

A horizontal needle deflected by a magnet in a tube on the same principle, was also exhibited; and this instrument seems to possess advantages over the *vibrating* horizontal needle, not only from the results being so readily obtained by its means, but also from its not being liable, like the other, to be more or less disturbed by the mechanical action of the air; in which currents are excited by very slight and partial changes of temperature, caused by the sun, wind, &c., or even by the warmth of the hand.*

The horizontal needle, on either of these principles, cannot, however, be employed with satisfaction, for ascertaining the intensity of the terrestrial magnetism at places very remote from each other; in such cases, it is necessary not only to know the inclination of the dipping needle, but also the deviation of the horizontal needle from the horizontal line, which must take place in a greater or less degree, at one of the stations, at least, if there be a considerable difference in the direction or obliquity of the terrestrial magnetism.

When the needle is vibrating, it is also more or less affected by the force of gravity, which would give it a certain direction, whilst the force and obliquity of the earth's magnetism would tend to coerce it in another; its vibrations must therefore, in some degree, depend upon the influence of a two-fold force, acting in different latitudes, in a constantly varying ratio.

If a sliding weight be used to restore the horizontal direction of the needle, it is evident that any change in the position of this weight must also affect the ratio of the vibrations. It seems, moreover, that an adventitious or temporary influence may be produced on the needle by its direction with respect to the earth's magnetism; it being greatest at the magnetic equator, where the directions of both correspond, and least near the poles, where the forces are nearly at right angles to each other.

The *dipping-needle deflector* is free from all these objections, and appears to possess many and great advantages over the horizontal needle, for ascertaining the comparative intensity of the terrestrial magnetism in different latitudes and longitudes; whereas, the horizontal needle is to be preferred, for local observations merely, and detecting minute changes of the magnetic intensity at any given place.†

* See Phil. Mag., 2nd Series, vol. i. page 310, for details on this subject, by Mr. Fox.

† The instrument just described was made by Watkins and Hill, No. 5, Charing Cross, London.

NOTICE OF THE PROGRESS OF THE HOT-AIR SYSTEM OF SMELTING IN GREAT BRITAIN.

(Sequel to M. Dufrenoy's Description of the Process, as used at the Clyde Iron-Works, inserted in our last No.)

In spite of the complete success of the experiments at the Clyde Iron-Works, the introduction of heated air into the iron-works generally of Great Britain encountered great difficulties. It was necessary to conquer not only the power of habit, but the prejudice generally existing, that coal is sulphureous, and that its transformation into coke is not only favourable to combustion in the smelting furnace, but that it is indispensable to the making of iron of good quality.

This plan, in use four years in the environs of Glasgow, has scarcely passed the frontiers of Scotland. However, the wonderful advantages which it has produced, have began to triumph over these prejudices, and gradually to extend its use in the different counties of England. I know of twenty-one works, containing sixty-seven furnaces, which work with hot air. In Scotland six; Flintshire one; Derbyshire three; Newcastle-on-Tyne two; Newcastle-under-Lyne two; Staffordshire five; Pontepool two.—Total twenty-one.

The iron made at these furnaces is generally No. 1, proper for casting the nicest work.

The plan is equally applicable to the metal intended for bar iron. To obtain this quality of metal, it is only necessary to change the proportion of fuel and mineral. The forges upon the *Tyne Iron-Works*, near Newcastle—of *Codnor Park*, near Derby—employ for the manufacture of bar iron, none but the pig metal produced in the hot air furnaces.

In most of the establishments cited, the crude coal has been substituted in place of coke. In some works, where this substitution has not yet been adopted, they assured me, as at Monkland Iron-Works, near Glasgow, that the temperature of the air was not raised sufficiently to enable them to pass from the manufacture by coke. In some others the quality of the coal being extremely bituminous, as near Newcastle, appeared to be an obstacle to the use of coal in the natural state.

The employment of hot air is not yet introduced into the great works at Merthyr Tydvil, Wales. The small consumption of coal which is employed crude, as I shall indicate at the close of this report, and the high price of the patent, has retarded its adoption—but I have no doubt that this plan will produce in this country a sensible saving in the consumption of fuel.

To appreciate the advantage which results from the employment of hot air, I will give a statistical view of the works visited.

Calder Iron-Works.—These works are three miles from Glasgow, on the Edinburgh road; the hot air blast has been used at them for three years past; two of the furnaces are fed by an apparatus like that at the Clyde Works, but at the other two the air is heated by means of an apparatus composed of two large horizontal tubes, six feet long, nine inches in diameter in the clear, and one inch thick, and nine small tubes, six inches in diameter outside, and three inches inside, doubling upon each other like syphons, which are placed vertically upon the large pipes, and well fastened. This system of tubes is placed in a rectangular furnace, ten feet long, three feet wide, and twelve or fifteen feet high. To prevent injury to the joints, care is taken to protect them from the direct action of the fire. The joints of the large pipes are placed outside of the furnace, and the connexions of the small pipes with the large are shielded by fire-brick. The flame is carried through the furnace by a longitudinal flue, passing the whole length; it is then spread among the tubes which it envelopes, till it gains the chimney.

The temperature of the air is raised by this apparatus to 612° Fahr., as at the Clyde Works; the consumption of coal is 7 cwt. of coal per ton of iron produced.

This apparatus appears to be preferable to that of the Clyde Works. It takes less room; the bends in the tubes, it is true, increase the friction of the air passing through them, but this circumstance appears to have but little influence on its motion. The power expended by the blowing engine is not greater than that at the Clyde Works, and the pressure of air is 2 lbs. 3 qrs. per square inch.

The expense of construction is quite small. The greatest part of it is formed of cast iron, which can be replaced at the works in case of accident. The cost of construction is estimated at about 33*l.* 15*s.*, requiring about seven tons of castings—say about one and a half tons for the large pipes, and five and a half tons for the small tubes. By estimating the iron cast into pipes at 5*l.* 8*s.* per ton, which is the average cost at the works using coal, the expense of each apparatus will be about as follows:—

Masonry..................	£22	10
Earthen parts of the furnace ..	13	10
Casting pipes..............	37	16
	£73	16

The expense will then be about 147*l.* 12*s.* for each smelting furnace. At Calder they estimate the cost at about 37*l.* 16*s.* to each tuyere. The apparatus at the Clyde is much more expensive;—the quantity of iron required is seventeen or eighteen tons, and the masonry twelve times as much as at the Calder Works.

The consumption of combustible has diminished from 7 tons 17 cwt. to 2 tons 2 cwt., and the amount of flux from 13 cwt. per ton of iron in 1828, to 5½ cwt. in 1833. This diminution must be charged to the increased temperature in the furnace by the use of heated air.

The quantity of air blast has been reduced from 3,500 cubic feet per minute to 2,627 feet, the pressure being reduced from 3¼ lbs. on the square inch to 2¾ lbs.

The expense of the fuel for heating air varies from 7 to 8 cwt. per ton of iron.

The consumption for the blast engine remains the same; but as the yield of the furnace has advanced from 5 tons 12 cwt. to 8 tons 4 cwt., the expense, divided on each ton of iron, is reduced from 1 ton 4 cwt. to 14 cwt.; the slack only is used for this purpose.

The consumption of ore has varied much, but, as the scoria never contains more than from .02 to .015 of iron, this difference depends on the quality of the ore, according as the *ball ironstone* (mine en rognous), or *flat ironstone* (mine en couche) is used.

At Calder, as in the Clyde Works, the daily production of iron has been increased in a great proportion; this circumstance operates powerfully on the price of fabrication.

The blast engine employed at Calder is made with two cylinders, one over the other, with one shaft, so that the pistons of both are attached to the same beam (*tige*). The upper cylinder is fifty inches, and the lower cylinder seven feet, in diameter, each being seven feet long; the stroke of the piston, which is nine inches thick, is seven feet, and it makes sixteen strokes a minute.

Monkland Iron-Works, near Airdrie.

The heating apparatus used at this establishment is similar to that at Calder, being formed with two large pipes, and a number of small tubes jointed into the large ones, the only difference being that they are placed horizontal. This difference of position, and diminished length of the tubes, prevent the temperature of the air from being raised so high as at Clyde or Calder.

At the time I visited Monkland, the air was heated to 450° Fahr., and coke was still in use for smelting. The economy in fuel and flux obtained at these Works, since the introduction of hot air, is nearly the same as at the Calder Works, when the air at that furnace was heated to 300° Fahr., and coke still used in the furnace.

Before the adoption of the new plan, the Monkland Works consumed from seven to eight tons of coal for each ton of metal; since that time there has been consumed,

4 tons	0 cwt.	of coal for smelting;
0	6	do. for hot air apparatus;
3	5	crude ore;
0	10	flux.

The daily yield is now six tons; the pressure of the blast two and three quarters of a pound.

Besides the Works of which I have treated, three others exist in Scotland, using the hot air blast; the results obtained in these establishments, by the adoption of the new plan, being similar to those cited, it appears useless to enter into details respecting them.

Iron-Works in the Environs of Newcastle-on-Tyne.

In the coal basin of Northumberland, the largest and richest in the kingdom, which furnishes almost all the fuel used in London and the vicinity of the Thames, there are but two iron-works:—

1st. The *Butterly Iron-Works*, six miles from Newcastle, on the London road—the other called the *Tyne Iron-Works*, on the banks of the Tyne three miles from Newcastle. This region does not abound in good iron ore, and the proprietors have been unable, after the most minute search, to procure mineral enough to supply these two works; but their position on the banks of the Tyne enables them, in spite of these unfavourable circumstances, to draw their supplies from Lancashire and Cornwall, at a cheaper rate than they can be obtained, for the most part, in our (the French) iron-works.

Both these works have used the heated air for a year past.

The Butterly Works, constructed but three years since, contain two furnaces, forty-five feet high, four reverberatory furnaces, and several cupolas; all the iron made is intended for castings.

The results given by the apparatus for heating the air are not sufficiently important to warrant a particular description. The apparatus consists merely of a tube, returned five times upon itself at right angles, and

disposed so that the cross section presents five circles, of which four have for their centres the angles of a rectangular parallelogram, and the fifth the point where the two diagonals intersect.

The tubes are placed horizontally, and are connected by bolts and nuts through lugs on the outside.

The interior diameter of these pipes is fourteen inches, and the metal one and a half inches thick; the length of the heated part is fifty feet, and the pipe is placed in a rectangular furnace, a little shorter than it, so that the joints and angles may not be exposed to the action of the fire.

The expenditure in fuel of this apparatus is about six hundred weight to the ton of iron produced. The pressure of the air is one and a half pound, being the same as before the introduction of the hot air. The velocity of the blast is a little less.

The charges of the furnace are as follows:

700 lbs. coke (this coal gives 45 per cent. of coke);

650 lbs. mineral roasted, being a mixture of equal parts of ore (*minerai houiller*) and the red oxide of iron from Lancashire;

400 lbs. flux.

From the register, it appears that there were made, in furnace No. 1,

July 10,	40 charges	or an average of 40.
11,	42	
12,	38	

The same furnace produced, in these three days, 23 tons 11 cwt. of metal, or a daily average of 7 tons 17 cwt.

By taking this data, we find that, to make one ton of iron at Butterly, they consume,

4 tons	0 cwt.	of coal for fusion;
0	6	coal in lumps, to heat the air;
1	18	ore roasted;
1	0	flux.

The quantity of flux employed is very considerable, because it is much charged with water, being a marly chalk, brought from the banks of the Thames by the coal-ships.

The mixture of ore, when roasted, contains 60 per cent. of iron.

To appreciate the saving which has resulted at the Butterly-Works, from the use of hot air, it is necessary to know exactly the consumption for a ton of iron, before the introduction of the plan. I have not been able to procure documents which would furnish this; but Mr. J. Hunt, the manager, assured me that the expenditure was seven tons of coal.

If we compare these results with those obtained in Scotland, we shall find that the consumption at Butterly corresponds nearly with that at Calder in 1830, when the temperature of the air was raised to 300° Fahr., and coke was still burned.

At Newcastle, the price of coal forbids its use in the crude state, because the lumps, which are worth one dollar and forty cents the ton, must be used; while the slack, at forty cents, may serve to make coke for this purpose. It is, nevertheless, advantageous to have the air a higher temperature.

2d. *Tyne Iron-Works.*—The consumptions of material in this work, for the production of a ton of metal, are nearly the same as at Butterly; but an important difference existing between these establishments is, that, at the Tyne-Works, a great portion of the pig metal is made into malleable iron. This iron, which is of a superior quality, is almost exclusively rolled into boiler plates. In the same furnaces, and with the same minerals, the two kinds of iron are made by varying the relative proportions of ore and coke.

Cupolas are also fed with heated air to great advantage, 225 pounds of coke being sufficient to melt a ton of metal.

The furnaces having been constructed since the adoption of the hot air plan, no comparisons in regard to economy could be instituted.

Environs of Manchester and Liverpool.

The *Rant* Iron-Works, near Wrexham, in Flintshire; the *Apdale*, the *Laneend*, and the *Silverdale* Works, near Newcastle-under-Line, Staffordshire, have adopted the hot air plan.

The apparatus used in these establishments is very like that adopted at the Calder Works. At Apdale precisely the same apparatus is used, and the results obtained since its introduction are almost identically the same as at Calder, the temperature of the air being raised to 600° or 612° Fahr.

The consumption of coal, formerly six tons to the ton of iron, is now reduced to three and a quarter tons. They still employ coke, the coal being sulphurous. The expense of the heating apparatus is 7 cwt. of coal to the ton of iron.

The quantity of flux is reduced in the same proportion. In July, when I visited Apdale, only one furnace was in blast, which had been five years at work, but only six months with heated air. Since that time, the yield of the furnace has been from six to seven tons per day; the iron produced being almost all No. 1; while before, the metal had been nearly equal parts of No. 2 and No. 3, the last being made into bar iron.

One work near Newcastle, belonging to Mr. Furnstone, has abandoned the use of the hot air blast. I should have endeavoured to ascertain the cause of this, had I learned the fact in time to visit the works.

THE UNDULATING RAILWAY — MR. BADNALL'S REPLY TO MR. STEPHENSON AND MR. WHITEHEAD.

Sir,—Although I feel convinced, from the communication with which you lately favoured me, as well as from other circumstances, that Mr. R. Stephenson, Jun.'s Report, "on the formation of railways by undulatory planes," found its way into your columns without the knowledge of that gentleman, yet the publicity which it has now attained demands that I should enter my protest against it in a more comprehensive form than I felt it necessary in the first instance to do, when I regarded it as a simple declaration of opinion, delivered by the desire and for the consideration of the Board of Directors, to whom it was addressed.

Indisposition has hitherto prevented me doing this—and, in now attempting it, I shall confine myself as narrowly as possible to the most important points in dispute, which, in their most essential bearing, are of a *practical* nature.

By reference to Mr. Stephenson's observations, it will be seen that, according to his own conclusions, if m be $=f$ on both railways, or, in other words, if *friction* be precisely balanced by the *mechanical force* employed, "a striking difference, and apparently not an unimportant one, exists between the undulating and horizontal surfaces." "Very little reflection, however," continues Mr. Stephenson, "is requisite to perceive that *this advantage is merely apparent, and not real.*" Now what, let me ask, is this advantage? Mr. Stephenson himself confesses that on the undulating line a body would, under such circumstances, "move onwards without interruption"—whereas, on the horizontal line, the body "would remain stationary." In this instance I venture to maintain, that the difference which exists between the two cases is of a *most important* and *most real* character.

But why does Mr. Stephenson differ with me in this conclusion? Because, he says, "let us suppose that the body at A, on the horizontal plane, has *the mean velocity given to it which gravity imparts to the body moving down the first inclined plane of the undulatory surface*, it will then (for reasons which he states, and which are obvious,) pass over the distances corresponding to each undulation, in the same space of time, whether the surface be undulatory or horizontal."

I concur with Mr. Stephenson—but why, to make the difference between the two cases *unreal* and *unimportant* does he give to the body on the horizontal line an artificial power, capable of producing a velocity equal to the *mean* velocity produced by gravity, and withhold that artificial power from the body moving on the undulating line?

Is it not, sir, a full, a clear, and an unquestionable confession, on the part of Mr. Stephenson, that supposing m to be $=f$ on each line of road, a velocity must be given to the body on the horizontal line, by artificial power, equal to that produced by gravity on the undulating line, BEFORE the two lines of road can be deemed of equal merit? If this be true, and it cannot fail, on consideration, to be as obvious to your other correspondents as it has proved to be to Saxula, to Mentor, and to Iver Maciver—what is the deduction? Why, evidently, that if m be equal to f on each railway, the undulating line is superior to the horizontal line, to the precise amount of the artificial power expended to produce a velocity on the latter, equal to the mean velocity produced by gravity on the former: Or if the *same* artificial power be given to *each* body, over and above the m which is $=f$, the velocity on the undulating line would be greater than *that* on the level line, to the exact amount of such artificial power.

Next—it is easy to *suppose* a power equal to gravity, given to a body on a horizontal line; but, both in theory and in practice, I have a right to insist that this power should be defined?

First, what is its extent?

Secondly, how is it to be generated?

With regard to its extent, let me suppose a case, keeping still in view the datum of Mr. Stephenson, that friction in each case is supposed to be neutralised—or that m is $=f$.

Now, on an undulating plane, it would not be difficult to acquire a mean velocity of 30 miles per hour, or much greater, if desired; and m being equal to f, the amount of load would be of no consideration. Taking an *extreme case*, therefore, to prove the importance of the difference, we will suppose 1,000

tons moving on the undulating line at such velocity. Will Mr. Stephenson, or any other opponent, inform me what extent of power, beyond that precisely necessary to neutralise friction, would be required to attain such a velocity on the horizontal line with a similar load? Could the extent of such power be less than *that absolute force of gravity*, which, in the other instance, produced a mean velocity of 30 miles per hour? If not, how is such artificial force to be generated? Certainly, by no other means than a proportional sacrifice of mechanical power. And whatever this sacrifice may be, so is the difference, as regards *this view* of the question, between an undulating and a horizontal railway.

It must not be forgotten, in considering the extent of the power necessary to produce the required velocity on the horizontal line, that (friction being supposed to be neutralised), the force required to move the load, at a velocity equal to that produced by gravity on an inclined plane, must not be *only that* which is requisite to equalise the motion on the level with the motion at the *commencement* of the descent, but equal to the mean velocity attained throughout the whole undulation. A single impetus given to the body on the level plane cannot, for a moment, be supposed to produce such a result. No; it must be a force whose effect would be equivalent to the effect produced by the force of gravity on such weight, after descending at least thirty feet perpendicularly in vacuo. And how, except at a proportionate sacrifice, can this force be found? I may be told, you will obtain it by descending a plane of sufficient inclination before traversing the level line; but would such an argument be fair, unless a similar advantage were offered to the undulating line? The question, whether practical or theoretical, has from the first been confined to the most advantageous mode of transfer from *one* level to *another level*, and as such Mr. Stephenson has fairly considered it.

I am now led to the consideration of the difference in the value of f on the two lines of road, which it will be seen, in accordance with Mr. Stephenson's data, I have hitherto regarded as equal on each. Such, however, is far from my opinion. I have proved, I trust, once again, to the satisfaction of at least a majority of your readers, that if even friction were the *same* on an undulating and horizontal railway, the former possesses, most unquestionable, *real*, and *important* advantages over the latter.

I now further maintain, that friction is *not* the same upon both railways. *Friction on railways is equal in equal times, and not (at varying velocities) equal in equal spaces.* Inasmuch, therefore, as a greater velocity is attainable by a given power upon the undulating than upon the level railway, in such proportion is the actual difference in the friction to be overcome by an absolute expenditure of mechanical force over equal spaces, measuring those spaces horizontally.

In other words, and repeating an observation I made some time ago, the pressure of all bodies on the surface of the earth is, in inverse proportion to the velocity with which they travel over the earth's surface; and as friction is dependant upon pressure, friction necessarily decreases as velocity increases. It is far safer to skait over a thin piece of ice than to walk over it. Why? Because pressure decreases as velocity increases.

It is proved beyond all question, that any uniform force, such as gravity down an inclined plane, will produce an uniformly accelerated velocity; or, in other words, although the force be the same through every second of time, the velocity increases as the squares of the times. Why? Because pressure, or the friction produced by pressure on the plane, decreases as the velocity increases. Further, it is a belief, founded on the strictest philosophical principles, that if it were possible for a body to attain a certain velocity—say, for instance, 1,600 feet per second, as being greater than that at which the earth revolves upon its axis—such body would no longer be under the control of that attraction which, under other circumstances, would confine it to our globe; but, revolving round another centre, and forming an orbit of its own, would be governed by the same laws which regulate the whole planetary system. If this supposition be not fallacious, how strongly does it corroborate the opinion that *pressure* or *friction* invariably decreases as velocity *increases*, or, in other words, that the force of a quiescent body, or the total pressure of that body on a plane, which force is properly designated by some writers the

vis mortua, gradually diminishes in intensity whether the plane be horizontal or inclined, as an increasing velocity is imparted to it. Thus the *vis motrix*, or force imparted to a moving body, overcomes the *vis mortua* in proportion to its extent; and, as the mechanical force expended in producing velocity varies as the velocity divided by the time, it is evident that the resistance which friction opposes to any constant mechanical force cannot be equal over equal spaces, for the spaces vary in a ratio compounded of the velocity and the time, and the velocity as the force and the time.

The necessity of establishing this point before a fair comparison can be made between the undulating and horizontal railway is self-obvious. My only surprise is how a single doubt can be raised upon the subject; and yet I know that a contrary opinion is entertained by many practical men, though I am glad to believe by very few mathematicians. If friction were equal, over equal spaces, at a varying velocity, a body rolling down an inclined plane under the influence of gravity (which may be regarded as an uniform as well as constant power), would pass over equal spaces in equal times. But what is the fact? If a given space be passed over in the first second of time under the influence of a given power, thrice that space is passed over in the next second of time under the influence of precisely the same amount of power. The resistance, therefore, which* friction opposes to motion down an inclined plane, whether rolling friction or axle friction, is *not* equal in equal spaces, but equal in equal times; and if it be so on inclined planes, how can it be otherwise on horizontal planes, if any constant force be employed to impel a body thereon? Am I not then justified in demanding the admission, that the greater the velocity the less is the absolute amount of friction to be overcome by mechanical force over equal spaces?

This admitted, why is less mechanical force necessary to propel a ton of goods on an undulating than on a level railway? Simply because a velocity is attainable upon one at a much cheaper rate than it is attainable on the other; or, in other words, a velocity is attainable, and can be *supported* on the one with a given assistant power, which it is neither possible to attain nor support with the same power upon the other. I cannot give a better theoretical proof of this than the following. Supposing m to be equal to f on a *level plane*, as stated by Mr. Stephenson, and an additional force of impact d be given so as *just* to move a body at the rate of one mile per hour. It is evident that, if it were required to increase that velocity to 20 miles per hour, the force of impact d must be proportionately stronger. But how is it with the undulating line? m being allowed to be equal to f at starting, and the same force d being communicated, the velocity soon increases, under the force of gravity, to 20, 30, or 40 miles per hour (according to the formation of the curve), without *any* required increase of the force of impact d.

Thus no ground of argument can be so erroneous or untenable as considering $m = f$ on a horizontal line, and m (of like value) $= f$ on an undulating line.

But I have been told that *time* is an element which, in the discussion of this question, ought *not* to be taken into consideration. But how is this reconcileable to the established fact that velocities are the proper measures of the intensity of forces, and will vary as the forces multiplied into the times* in which they are generated?

It is true that, on level railways, when a *maximum velocity* is attained, friction is equal over equal spaces; but in proportion as the power requisite to attain and support such maximum velocity would be more efficient (as already proved) on an undulating line, in such ratio is the difference in friction, practically speaking, between the two lines.

Mr. Stephenson alludes to the momentum being alike at the termination of each of the model railways. This I have tried with contrary results; but Mr. Stephenson's own theory proves, beyond all

* The resistance of the air is not taken into consideration in either case; but the comparison is simply confined to the rolling and axle friction. It is true, that as locomotive engines are now constructed, the friction of all the *moving parts of the engine* must be increased with the increased velocity of the wheels; but this will no doubt be remedied, as it is unquestionably an erroneous mechanical arrangement.

* Mr. Nicholas Wood, in his Treatise on Railways, and speaking of locomotive engines, justly observes—"The leading object of all machines, especially of this kind, is to perform a definite quantity of work in a given time."

doubt, that, if the same artificial power were absolutely and effectually employed on both lines, the momentum, after traversing equal distances, ***must be*** in favour of the undulating line; inasmuch as the velocity of the one (m being $=f$) would be greater than the other, as *already* proved, and momentum is velocity $\times$ weight.

Mr. S. also states, that "it has been urged by some that the undulatory surface has an advantage, from the friction being reduced in consequence of the body being on an inclined surface, which," he adds, "a moment's consideration will show never can apply in practice." I, for one, have argued, and still argue, that *such is the case*, and that its application will be proved of invaluable practical importance. My meaning will be obvious, when I again repeat that friction is *equal in equal times*. Referring, then, to Mr. Stephenson's diagram, if a body start from A to C, along the level line A O C, being impelled by a given force, and the same body traverse the undulation A B C, impelled by the same force, the difference in the time of traversing the two lines will prove the difference in the resistance opposed by the pressure on the plane to the motion of the body.

As the preceding remarks will as fully apply to the observations of Mr. Whitehead as to those of Mr. Stephenson, and especially as my views, in opposition to those gentlemen, have been so ably supported by Saxula, Mentor, and Iver Maciver, I with pleasure waive any further theoretical allusions to the subject.

I now turn to practice—for, however meritorious the establishment of a new and important theory may be, I confess I would not have devoted the attention which I have done to this discussion, did I not conscientiously believe, and sincerely hope, that most beneficial practical results would, in the end, ensue from it. Prejudice may retard my object for a while, or reasonably-grounded doubt may interfere with its promotion, but I am not to be driven without a much stronger struggle than I have hitherto encountered, from the position in which I am placed; and I hope the majority of your readers will agree with me, that I should not be justified in retreating until ***positive, clear, unquestionable proof*** determined that *that* which was ***sound*** in THEORY was ***unsound*** in PRACTICE.

Mr. Stephenson's first practical objections are confined to an opinion that, although he considers the introduction of my plan would reduce the expense of constructing public lines of railway, its adoption would be attended with *greater expense in the carriage, greater uncertainty in the operation, in many cases with greater inconvenience, and in all with greater risks of accident,* than on a horizontal railway, or one approaching to it as nearly as circumstances would permit. Mr. Stephenson's last and main objection is, that *greater ultimate expense would arise, in part from the additional wear and tear both upon carriages and engines, from the varying velocities which must be continually taking place throughout the whole length of the line of road.*

As the greater expense of carriage, to which Mr. Stephenson alludes, is attributed to, and is entirely dependent upon, his last objection, I will jointly consider them.

A reference is made by him to the *Rainhill and Sutton inclined planes*, as a proof of the objectionable nature of inclined planes in general; and those planes are mentioned as being the PROBABLE cause of a very large wear and tear of the locomotive engines on the Liverpool and Manchester Railway.

Now, Mr. Stephenson's opinion on this head will not admit of *a single doubt*—there is no probability in the matter: the Rainhill and Sutton inclined planes are most inveterate obstacles, not only to the advantageous employment of locomotive engines, but to the advantageous employment of the capital embarked in the Liverpool and Manchester Railway. But can Mr. Stephenson ***seriously*** compare the ***labour***, the ***straining***, the ***incapacity***, of an engine groaning up the Rainhill or Sutton inclined planes, until an assistant engine relieve it partially from its difficulty, to the natural ease with which such engine would ascend under the influence of momentum, acquired by gravity on a corresponding descent? NEWTON tells us that a body moving in any circular arc sustains no loss of velocity by changing the direction of its motion. How is it, then, that machinery is so imperfect, that it cannot be applied with the greatest economy where nature is most economical? The proof

of all this is wanting. Mr. Stephenson has no more right to compare a section of the undulating railway to the Sutton or Rainhill inclined planes, than to compare a locomotive engine as it now exists, upon the very best principle, to what *it is capable of being.* The Rainhill and Sutton inclined planes are, as Mr. R. Stephenson well knows, bitter blots upon the fair pages of the ledgers of the Liverpool and Manchester Railway Company —blots, I freely confess, which his talented father could not (from the opposition which, when the railway was first constructed, was so strenuously urged against his original plans) prevent; but which will most assuredly bear out to the fullest possible extent, the assertion of Mr. S. jun., as to the wear and tear of the engines employed upon them. I answer Mr. R. Stephenson's argument, therefore, by observing, in allusion to the Rainhill and Sutton inclined planes,—

First, that the comparison is inconsistent, inasmuch as the causes of the wear and tear of the engines on such planes would not, or ought not, to exist on well-devised undulatory planes.

Secondly, that the *line of motion*, which is acknowledged by our most eminent philosophers to be the *best line*, is, until proof be given to the contrary, the most suitable line for the advantageous development of locomotive power.

Mr. Stephenson, in defence of the same positions, states, that as the engines at the bottom of an undulating line attain a velocity considerably greater than what is required upon a horizontal line, *three* objections, neither of which is undeserving of attention, arise—

First, he says—In the construction of these machines, it is a consideration of the very first importance to proportion and adapt the relative speeds of the different parts to the velocity at which the engines are intended to travel; and he adds his opinion, that although he is aware that these engines are worked at different rates of speed, yet he is convinced that uniformity in the velocities is extremely desirable, and that they never perform so economically as when the intended velocity is adhered to within very narrow limits, *which is quite impracticable on an undulating road.*

Now, in answering this first observation, I would beg to ask what obstacle there is to the speed of a locomotive engine being proportioned or adapted to any required maximum velocity on an undulating railroad? Mr. Stephenson cannot, I think, dispute that, if the wheels of an engine were so far increased in diameter as to admit of a maximum velocity being supported on a level railway with two-thirds of the present number of the strokes of the piston, great difficulty would be found in moving what is now a *full load* from a state of rest to such maximum velocity. To render my meaning clear, we will suppose that the wheels of any locomotive engine now in use were increased to seven feet in diameter, in such case, I have no doubt that the difficulty of moving what is now a full load from a state of rest, would be increased in proportion to the advantages that would be derived from such change at high velocities. But how does this apply on an undulating surface? Gravity at once affords the high velocity; and the engine, calculated to run at such high velocity, can support the motion with that heavy load which, without the assistance of gravity, she could not have moved from a state of rest. It is this consideration, in part, which has always led me to maintain that far heavier loads can be conveyed on an undulating surface than on a level surface, with the same description of engine; and the experiments on the Sutton plane fully verified my position. Indeed, if it be true that it requires more power to move a body from a state of rest to a given state of velocity, than it does to support that velocity when obtained —and such is an undeniable truth—are we not again obliged to give the preference to the undulating railway? A preference, in this case, founded on a practical illustration of the truth of Mr. Stephenson's own theory; viz. — "On the undulating line the body would move onwards; whereas on the horizontal line it would remain stationary," unless, that is, an additional force of impact were given, which would not be required on the undulating plane.

With regard to *uniformity* of velocity, I am aware that *it is* desirable in most cases, but in none more so than on level railways, where the want of it produces all the disastrous circumstances which Mr. Stephenson so much fears would re-

sult upon an undulating line. On a level railway an engine, calculated for rapid speeds, must either carry limited loads or strain herself by endeavouring to attain a high velocity with too great a load; or if calculated for low speeds, she is too often with heavy loads strained and injured by being pressed at a velocity for which she is not calculated. Again, upon the Rainhill or Sutton inclined planes; on the ascents she is injured by being often overladen, and on the descents by the succeeding carriages pressing her, in many instances, beyond her natural speed. Now, how would this apply upon an undulating surface? If an engine were particularly adapted to run at a very high velocity, she never could be injured by her velocity being diminished, as it would only be diminished when she had absolutely no work to perform; and the acquired momentum which permitted this diminution never could, on undulations properly constructed, be such as to force or press her moving parts beyond the speed for which they were adapted.

Nor would such engine be strained in the attainment of the high velocity with heavy loads, but the loads she would be enabled to convey (gravity so kindly and so naturally assisting in producing the required velocity) would be infinitely greater than she could possibly move upon a level surface. She would, in fact, combine the advantage of the slow engine as regards its power of moving heavy loads from a state of rest, with the fullest possible advantages of the rapid engine which could, on a level line, continue without doubt to move such loads, if it were *only* in her power to attain with them the required velocity. It must not be supposed, from these observations, that I conceive an extension of the diameter of the wheels the only means of very rapid velocities being supported, without a proportionate increase in the number of the strokes of the piston; on the contrary, I firmly believe that a locomotive engine never can be considered anything but imperfect, until the action of the piston is less connected than it now is with the action of the wheels; or, in other words, until the wheels *may* be moving fast while the piston is moving slow.

In answer, therefore, to Mr. Stephenson's objection on this head, I fearlessly assert that *the irregularity of motion on an undulating line never can be so injurious to an engine adapted for quick speeds, as the irregularity of motion and the incompetency of the action of such engine on a horizontal line.**

It is true, if an engine calculated for very slow speeds were placed on an undulating railway, Mr. Stephenson's objections would be valid—the velocity might be too great for it. But why employ such engines, when (which is not the case on a level line) engines adapted to quick speeds, if of proportionate powers, are far more applicable to the purpose, and can convey equally heavy loads? A heavy cart-horse may move four or five hundred weight more than a thorough-bred horse from a state of rest: but press him beyond his natural speed, and you strain him and destroy him. Who would employ such a horse upon any undulating surface? Would not the assistance, which gravity could otherwise afford, be an impediment to his progression? On the other hand, let gravity move the load from a state of rest, and let the thorough-bred horse only keep his heels out of the way of the load, employing all necessary power, but never overstraining himself, and which will suffer most from the effect of their labour?

As long as the velocity produced by gravity were limited within the canter of the horse (and on undulating railways this limit is easily calculated in reference to engines), who shall tell me that the animal would suffer injury by its speed being slackened from the gallop to the canter, or *vice versâ?*

I may be told that this comparison is a false one, but I deny it. Nature is no bad instructor. The stage-waggon driver will tell us that a level road is best for his heavy cattle — the mail-coachman, that a moderately undulating road is best for his more nimble steeds. It is yet to be determined which description of road is best suited to the effective employment of locomotive power.

Secondly, Mr. Stephenson says, "when the velocity of such engines exceeds that

* Much of the wear and tear of engine-wheels and rails, on horizontal lines, is evidently owing to the slipping of such wheels, which an undulating line would certainly obviate.

for which they are calculated, the steam acts less forcibly on the pistons, and thus produces an absolute loss of power; or, in other words, an increased consumption of fuel."

No doubt of it: but why should the velocity on an undulating road *exceed* that for which the engine is calculated? The high opinion I entertain of Mr. Stephenson's mechanical ability will not allow me to entertain so preposterous an opinion, as that *he himself* cannot practically remove all question upon this subject. I have frequently heard his father state that an engine might be constructed to travel safely at a much greater speed than I have ever contemplated, as likely to be attained (at present) on an undulating line of road. I have frequently heard his uncle express a similar opinion; and to the opinions of no mechanical men in Europe would I bow with greater deference on such subjects. Moreover, may not the steam be frequently *bottled* up (as an able correspondent termed it) on an undulating line without unnecessary sacrifice of velocity; but how can this be accomplished on a horizontal line?

Thirdly, Mr. Stephenson says, "From the present construction of locomotive engines, every different speed of travelling is accompanied with a corresponding increase or diminution of the temperature of the fire, which occasions a continual working amongst the different parts of the boiler, from unequal expansion and contraction, which never fails in a short time to render the boiler more or less leaky:" in addition to which Mr. Stephenson adds,—"I mention this to show the tendency of the undulating railway would be to aggravate the evil arising from great inequalities in the temperature."

I maintain that the inequalities of motion upon an undulating railway would not be greater (if properly constructed), than the irregularities of motion on a level railway; or, if more frequent, not more perceptible, and not more injurious to either engine or boiler. *The very slight declivities necessary to produce the desired effect, have not been sufficiently taken into consideration: and, where a saving in the expense of constructing the road would lead to the adoption of deeper undulations, sufficient weight has not been attached to the fact, that any intelligent engine-man will be fully capable of so controlling the engine, as to regulate the velocity and the economy of steam, according to circumstances and convenience.*

Supposing, however, that some additional inconvenience should arise as regards the duration of the boilers—and I cannot conceive why it should—I can only beg that it may be placed to the *debit* of the invention, giving me *credit* for the opposite advantages.

Mr. Stephenson affirms that the above are his reasons for concluding that the expense of carriage would be greater on the undulating line, and also for his supposition that the operation would be attended with greater uncertainty.

After what I have stated in reply, I need scarcely repeat my observation, that I am indifferent to the establishment of the theory, if my opinion of the undulating line being, *in economy* and *in effect*, superior to the horizontal line, is not fully borne out in practice.

Mr. Stephenson's next objection is one to which public attention has been more directed than to any other and it is one which, at first sight, appears to be most fatal to the success of the undulating railway.

I allude to the following paragraph:—"Inconvenience would, in my opinion, result from not having the power to halt at any given point on the railway," &c.

In answering this objection, I will take two views of the subject—.

1. How would I meet this objection on a line of road where there were many natural undulations, and where the saving of expense in the construction were very important?

2. How would I meet this objection on a line of road which was level, or nearly so, by nature, and which it might be deemed necessary to throw into gentle undulations, for the sake of travelling at greater velocities, and with heavier loads?

In the first instance, unless an object of considerable importance, I should conceive that 1000 to 1200 yards would be a sufficient length of undulation, and (until proved to the contrary by experiment) I should imagine that a dip of fifteen feet, or even much less, in such distance would be ample. Now, in such case, what objection could there be to every stopping place being within a reasonable distance of the summit of each undu-

lation, and what difficulty would there be in the engine being stopped within a reasonable distance of such resting place? The stopping places on the main lines must be determined before the lines are completed, and if new branch roads should afterwards be required to join such main lines, they must, of course, be made subservient to the main lines in every point of view.

No declivity should be so steep as that a carriage cannot be conveniently stayed by the application of the brake, unless a case of necessity or of expense, should render such precaution unnecessary, and this being allowed, wherein does the practical difficulty exist to which Mr. Stephenson alludes?

On the Manchester and Liverpool Railway many of the *stopping places* are far above the level of the bye roads which *conveniently* lead to them; and supposing *that* railway to have been constructed on the undulating principle, would it (I ask Mr. Stephenson) have been requisite to change those stopping places? I maintain that it would not—inasmuch as the stopping places which are on the level of the Railway *now*, would have been on the *average* level of the undulating railway, had the whole line been constructed on *that* principle. There can be no fallacy in this—there can be no reasonable ground for disputing that a stopping place may, with equal propriety and convenience, be made on the average level of an undulating railway, as on any part of a horizontal railway—aye! and with greater convenience on the former than on the latter; for on the undulating line, the stoppage may be made, and the maximum velocity attained in *far* less time than upon a level line.

In answer to the first position, therefore, I argue, that if a railway be laid down with undulations exceeding in length (and of requisite depth) the average length of the trains, the stopping places ought to be as near the summit of the undulations as convenient; that no greater inconvenience can possibly accrue from the stopping places being on the *average* level of an undulating line, than on any part of a horizontal line; and, lastly, that an engine possessing her full power of progress can stop more easily, and move onwards more easily, on an undulating than on a level surface.

It will be seen, by the above explanation, that I will not even admit the propriety of the stopping places being on *level surfaces*, unless it be found advisable at town stations, where a few moments' delay might be conveniently allowed for *those* carriages, which, from the *excess* of load above what the engine may be found capable of moving on the level, being pushed up to the engine by the attendants at the station. The time, however, that will be saved in acquiring the full velocity will more than compensate, in any event, for such delay.

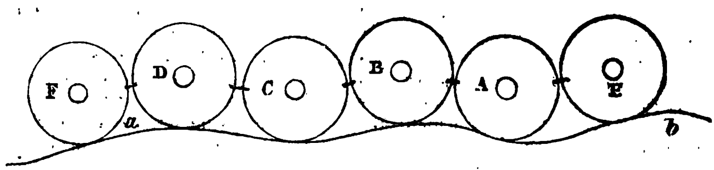
I now approach the second position, viz.:—How would I meet Mr. Stephenson's objection on a line of road which was level, or nearly so, by nature?

In the first place, avoiding a dead level as a nuisance, and as a source of a most exorbitant and unnecessary waste of power, if more extensive undulations were objected to, I should seriously consider whether it might not be advisable to throw the line into numerous small undulations—say, for instance, of 100 yards each, and from 1 to 1½ feet in dip—so that the full train of carriages might be interspersed over several gentle undulations. If these were found to produce the same results as larger undulations, the difficulties of stoppage would be altogether obviated. Experiments, however, can alone determine this question. I am, however, inclined to believe that undulations, however short, would prove far more advantageous than the dead level, as the assistance of gravity in producing velocity, and proportionally reducing pressure, would still be of effectual advantage.

Supposing, for instance, the train of carriages were interspersed over several undulations, and *at starting* all their chains were *slack*, it may be urged, that if the engine were propelling, instead of dragging, she might, in some cases, have to put the whole train in motion at the same time, and, therefore, that she could not *move* with a greater load than upon a level line—though, when in motion, the velocity would be greater in proportion to the momentum acquired in the descent of each undulation.

Reverse the case, however, and suppose the engine in front of the train, and situated at the summit of one of the undulations;—at starting, she would immediately tighten the chain between herself

and the first carriage, which would be continued to all the carriages on the *ascending* line of the undulation nearest to her: a preponderance would thus be given, as regards the rest of the train, in favour of the descending carriages; and this preponderance would, exclusive of the hauling power, assist in the production of velocity. I shall, no doubt, be asked—what! does Mr. Badnall believe that the engine will not have to overcome *all* the friction of the train, precisely as if such train were on a level? I answer that I do believe it; but inasmuch as I am indebted to gravity on larger undulations, so will that assistance be effectual to me, under the proposed circumstances in overcoming the *vis inertia*, and in relieving pressure by increasing velocity. For instance,—



A B C D are supposed to be a train of carriages of any given number, and of any given length—say 100 tons; and E the engine in advance. Let the point *a* be on a level with the point *b*, and the dip of each undulation to be sufficient to enable any carriage placed upon its summit *to descend freely by gravity*. Now, to set this train in motion (the chains being all slack at starting), it is evident that, when the chain between A = 25 tons, and E is tightened, by E dragging A, the whole train is rapidly got into motion; for, on A ascending, B follows by gravity, tightening the chain which unites it to C, and D falling by gravity assists in the rise of C. Next, supposing A to be the engine, and F another carriage, it is evident that D and B would assist the engine A to haul the ascending carriages F and C.

Then comes the question of friction: in what respect does it differ from the level railway? In *one very* important respect: on the level railway, the engine has to overcome the whole *vis inertia* of the load, which may be regarded as a resisting force unconnected with the friction which the engine would be able to surmount, when a given velocity was attained. Now, by reference to the diagram, it will be evident that the *vis viva* of the carriages represented by D and B is only restrained by the *vis inertia* of F and C; the one, in fact, is a precise balance to the other, half the train being inclined to move onwards, while the other half is equally inclined to remain stationary. Again, supposing the carriages F D C B were situated as in the diagram, and friction were supposed to be annihilated, B would move until its chain were tightened, and the momentum which it would acquire, however trifling, would be a sufficient force of impact to produce motion in the succeeding carriages.

But look at the position in theory of D C B A E. Though on a dead level, as regards the engine and last carriage, it is perfectly evident that, if friction were neutralised, the preponderance that would be afforded to D B E would effectually overcome the *vis inertia* of C A, and velocity in proportion to the dip of the undulation would be acquired by the whole train.

In justice to Mr. Cheverton, I ought to mention here that his frequent observations as to the overcoming of the *vis inertia* being the *only* advantage gained upon the undulating line, are strongly corroborated by my present remarks; but it is the ulterior consequence of such advantage that I have been always anxious to substantiate. The advantage *once* given, never can be lost; inasmuch as it enables a load to attain a velocity by gravity on an undulating line, with a power that could not produce that velocity on a level line; and such velocity being *once* communicated on undulations, would still be supported or *increased* to any desired extent by the economical *combination* of the forces of *gravity* and *steam*.

I have entered more fully than I intended to have done into this subject, so

impressed I am, the more I reflect upon it, with its importance.

Next,—it may probably be found desirable to have the descending lines of the undulations longer than the ascending ones; but, whatever may be ultimately decided upon as the best practical form of curve, the stoppage of the trains may, without any doubt, be most conveniently arranged.

To the eye, or to the feeling, such undulations as I propose, whether long or short, can scarcely be perceptible*—certainly not disagreeable, and unquestionably not unsafe. Indeed, as regards danger, the facility with which the engines can be stopped would be greater on a properly-constructed undulating line than on a level; and, as to increased velocity, who would not (if there be danger at all), prefer having his life in jeopardy for *one* hour than *two?* And at what speeds, let me inquire, have accidents hitherto occurred, especially the breakage of the axles? Nearly if not ALL have broken at slow velocities.

With reference to an engine falling lame at the bottom of a long undulation,—should such undulations be found best,—(and the train should only be allowed to stop, when such stoppage was unavoidable,) I have only to say, that the same remedy must be adopted as that now in use; viz. — *the engine must be assisted.* A simple bursting of a tube need not stop the train at the foot of the undulation, for there would always, *or ought to be,* sufficient momentum to enable it to reach the summit, and if it should unfortunately upset, I cannot conceive the difficulty greater than that which, under like circumstances, must be overcome, on a dead level. It will be argued, that the velocity attainable on short undulations cannot be so great as upon larger ones of similar dip; *not so soon,* certainly, but I think *as unquestionably,* and with equal loads. The very doubts, however, which must naturally be entertained on this subject, demand that *an effectual trial should be made,* unless, which I strenuously deny, Mr. Stephenson, jun., or other men of equal ability, can *prove* the undulating railway to be a farce both in theory and in practice.

Lastly, as to the trial recommended by the Manchester subscribers to the London Board, supported by the opinions of Drs. Dalton and Lardner.

The copy of the memorial, which is subjoined, will be a convincing proof that the memorialists were not misled under the supposition that eight or ten miles of ground would be required for the experiment. In fact, it was the opinion of the engineers to whom the memorial bears reference, that *a single* undulation would be sufficient to try the effect of the system; and it was also their opinion, that 500*l.* would be an ample sum to expend on such trial, as the undulation might be formed where cuttings or embankments were, in any event, necessary. It is true, that Dr. Dalton and Dr. Lardner recommended a more extensive trial, as being requisite to a full development of the question; but it cannot be supposed that the sum of 500*l.* could be considered by either of them as a sufficient outlay for an undulating railway ten miles in length.

To meet the propositions of Drs. Dalton and Lardner, however, Mr. Stephenson, remarks that 8,000*l* to 10,000*l.* would be the cost, — and supposing it even to be so,—should not *the fact* of there being a question in Dr. Dalton's mind upon the subject as one of the most eminent and experienced philosophers of his day,—and on Dr. LARDNER's mind, as an individual of most eminent mathematical attainments, and one of the most industrious and useful compilers of his age,—excite *some* feeling of caution on the part of *all* Boards of Directors, of *all* engineers, and of *all* railway subscribers, before thousands upon thousands are expended which might possibly, by a few simple experiments, be avoided?

But I have done,—repeating, merely, my firm and conscientious opinion, that no greater mechanical error can possibly be committed, than that which an engineer would be guilty of, in laying down a railway *horizontally.*

One word to Mr. Robert Stephenson, jun.:—I trust he will believe me, when I disclaim any wish to attract him, by this communication, into further discussion.

* The very erroneous impressions that have been formed on this subject, render me exceedingly anxious that the idea of deep and dangerous undulations should be exploded. Carriages will descend rapidly by gravity down any inclination of 1 in 200: and such an undulation, while it would produce ease and regularity of motion, could otherwise be scarcely perceptible.

I have no such object. His report, publicly appearing, demanded my public reply. I write in self-defence: and in self-defence I will continue to write, unless fairly, clearly, and effectually conquered. When that takes place, I will, with all my heart, confess the weakness of my cause, and sign honourable articles of peace; but, until then,

I am, Sir,
Your very faithful servant,
RICHARD BADNALL.

Farm Hill, 27th April, 1835.

P.S.—I ought to mention, that not having seen any number of your Magazine of later date than the 28th March, I am entirely ignorant of the nature of any communications which may have since appeared.

Memorial from certain Proprietors of the London and Birmingham Railway, resident in Manchester, to the Board of Directors of that Railway.

We, the undersigned, being shareholders to a considerable amount in the London and Birmingham Railway, consider it our duty to submit to the Board of Directors our opinion of the propriety of an immediate and effective trial being made of the merits of the undulating railway, in order that a correct estimate may be formed of the advantages (if any) which may arise from its general adoption, or that its inferiority, to a horizontal line of road, may be satisfactorily established.

We are the more anxious that this important preliminary experiment should be made, from the fact, that many eminent engineers and scientific individuals, well acquainted with railways and locomotive power, have expressed their decided opinions in favour of the undulating theory, and their conviction, that a great diminution of the expense of railway traffic, and in the original formation of the line, would result from the adoption of such principle; which opinions are strongly corroborated by the issue of the many experiments which have been, up to this period, carefully instituted, though not, we conceive, upon that scale upon which a decided judgment may be formed.

We are also strongly influenced in submitting this recommendation to the consideration of the Board of Directors, from the trifling expense (which is estimated not to exceed 500*l.*), which, even in case of failure, would be incurred; and we think, after the different arguments and experimental results which have been laid before the public on this subject, that a full trial of its merits would not only be an act of prudence on the part of the Directors, as protectors of the interests of the shareholders in general, but of considerable national importance, as well as a reasonable act of justice to the inventor.

Signed by Shareholders to the amount of one hundred thousand pounds.

N.B.—The above memorial (in substance, if not literally copied) was presented to the Board of Directors at a meeting in Birmingham, in the month of February, 1834, accompanied by letters from Drs. Dalton and Lardner.

The Directors, in consequence, I believe, of Mr. R. Stephenson jun.'s Report, declined to try the experiments; and, although I am convinced (which I assured the Directors) that Mr. Stephenson expressed a most candid opinion, and was guided in opposition to my views solely by a sense of public duty, yet I cannot but deeply lament, that even his opinion (however deserving of respect his Report might be) should have so long delayed the final settlement of a question upon which so great and so powerful a variety of opinion exists—a question, too, which, if decided against my system, could not be productive of any serious inconvenience—and in favour of it, would be productive of immense advantage to all new railway proprietors and to the public at large.

R. B.

MR. EXLEY'S NEW THEORY OF PHYSICS.—REPLY OF MR. EXLEY TO MR. CHEVERTON.

Sir,—Yesterday evening I received your 147th Part for April, when I first saw Mr. Cheverton's remarks on my theory, respecting which I beg to present a few observations.

We are frequently misled by terms; the most circumspect often wander on this ground. Mr. Cheverton has explained, and, in his sense, I never imagined the theory "mature;" it would be a prodigy for an infant to attain at once the full powers of manhood; the true doctrine of the planetary motions was not brought to maturity even by Newton himself. "Premature attempt" was understood by me as referring to the introduction of the theory, to its birth, its appearance in the world. But it is not allowed to be "*at present* successful;" yet it is granted to be in accordance with a multitude of facts, and the opposite has not been shown, respecting one single fact: hence, thus far it is successful, and will go on to maturity.

Mr. Cheverton remarks, that, by adopting exclusively certain principles, and the strict synthetical method, reasoning *à priori*, I have excluded myself "from the more satisfactory analytical proof." This is said unadvisedly. A little thought would show, that these principles are not adopted arbitrarily, but are themselves analytical deductions, and, although named postulates, they are such only in a certain sense; they are not arbitrary demands, but the demands of nature herself, the very results of that "more satisfactory analytical proof." Mr. Cheverton has indeed well said, they "are neither fanciful nor improbable; nay, there is every analogy in their favour." These principles he has criticised under six heads; some of the remarks are good, of others I cannot approve; but he has, with great propriety, presented his readers with the postulates and their corollaries.

The first two heads relate to attraction and repulsion. Mr. Cheverton professes to show what I require, respecting these principles; this is done neither rightly nor fully: permit me to explain my own meaning. Newton considered gravity as somehow appended to every particle of matter, but not as its essential property, though some of his followers have done so; this was injudicious. Newton was right, because we cannot imagine that any thing can exist, operate, and produce effects, where no part of that thing exists. Since then the force called gravity, and matter, taken in the Newtonian sense, are totally distinct and different things, we must consider them as appendages of each other. Now, of the one, gravitation, that it really exists, we have the fullest proof by analysis—proof drawn from observations on falling bodies—from the moon's orbicular motion, and those of the planets and other satellites —the perturbations produced by their actions on each other—the tides—the precession of the equinoxes—the nutation of the earth's axis—motion of the aphelion—lunar inequalities, &c., and even from motions observed in some of the stars. Hence we are constrained, obliged, by the most legitimate rules of philosophy, to conclude that a system of gravitating force belongs, not to the whole body singly, as one, but to every, the most minute particle, or atom, in its composition. Analysis carries us upward to the extended heavens, and downward to the unextended centres of atoms; and we have the best proof that can be, "the more satisfactory analytical proof" of gravitation. But analysis also shows, that repulsion exists near the centre. Now, repulsion is not necessarily another force—it may be the same force acting in an opposite direction: hence we have just and perfect right to conclude, that gravitation extends to the centre of atoms, while near the centre its direction is reversed. But no just analysis has ever fairly brought any philosopher to Newton's solid atoms, or other sorts of attraction or repulsion: had I then admitted these, I must have rested on arbitrary hypothesis; but now I stand on solid rock, as to the first and main postulate, the grand principle.

The third head may pass; the fourth states that "the force of attraction must belong to something;" that, however, no man can affirm rightly, till he tell us what force is. If by "something" he means substance, all that can be affirmed is, that it must either be something, or must belong to something; words are not the things they express; often the force of a word has produced error. Gravitation exists, we are sure, but whether as a substance or property, we know not; I incline to the former, but by no means decide. The decision does not, cannot affect my theory; and I stand equally distant from idealism, however that question is determined.

The fifth head is clear. Not only the author of the theory, but nature herself, makes the requisition called the second postulate; to this, analysis conducts us completely. Hence all these principles rest on the basis of truth; and I have consigned conjectures to the winds.

In the sixth head, Mr. C. thinks the distinction of atoms into two widely different classes is not conformable to analogy; my head thinks otherwise. It is true, that frequently the shades of difference in natural things are such that we cannot trace the separating line; in others it is barely distinguishable; in some, fairly marked; in others, still more evident; in some, it is a broad line; often there is a slight difference in some respects, and a very great one in other particulars. Just so the atoms of the common class differ, by various small gradations, both in force and extent of the repulsive sphere: the same holds of the other class, which though they possess precisely the same nature, and differ probably but little in the

magnitude of their spheres of repulsion, yet a broad line separates their quantities of force; but what is of more consequence, phenomena indicate this distinction. Philosophers of name, it is true, have considered caloric and light as mere qualities; but they have laboured in the dark, and must labour in the dark, while they hold these doctrines. At the same time, although I have reckoned only two classes, as being enough, as it seemed, for my purpose, yet I think it probable that the electric fluid, which I have classed with the ethereal, may form an intermediate class, approaching that which constitutes light and caloric.

But it is asserted respecting gravitation that, "in truth, the more energetic elements have every appearance of being exempt from such control." This is said, but not proved; the contrary is true. No indication of any other force is presented in any phenomena of the heavenly bodies, and the voice of all their actions makes it appear that gravitation belongs to every atom of matter.

We now find an inquiry, "Who shall make it an axiom that they (bodies) cannot act where they are not?" Answer—Common sense. And in spite of the metaphysical arguments, a man of common sense will not allow that any thing can act where it is not, and where no part of it is.

But it is stated that in my theory "various subsidiary hypotheses are introduced, for which no reason can be assigned but their convenience, and no proof but their fitness to make facts and theory accord!" This I am prepared to controvert and disprove. Difficulties, indeed—not only some as stated, but many and great—must have stood before me, as every one will own who knows the subject: but I have introduced my subsidiary hypotheses, while traversing the regions of common physics. Although I feel proud in having overturned and swept away the perplexing, misguiding, darkening shadows and cobwebs of a multitude of hypothetical principles, I do not, at the same time, advocate the necessity of few principles in nature; but feel bound to take only such as I find, one, two, or many. Organic matter seems to require only those I have introduced as my foundation. In my concluding remarks, it will be found stated that vegetable life requires one principle, animal life another still higher; sense and reason require different principles: the highest we know of is the moral principle, which gives to man a capacity for religion, and which when pure, associates man with his great Author, the only Self-Existent Being, and Universal Lord, who takes pleasure in the creature he formed himself, as a father in the questions and answers of his infant child: as examples, look at Enoch and at Abraham, the friends of God.

But Mr. Cheverton, trying to make good his point, gives what he calls an instance of a subsidiary hypothesis. It respects magnetism, and is stated as a quotation, p. 20, No. 609, but I cannot find it in my work. At page 258, New Theory, my words are, "Now the magnitude of the spherules, and forces of the atoms or particles which compose some conducting bodies, may be such, that they shall be susceptible of receiving and retaining the impressions of the above-mentioned currents to a certain depth on their surfaces, and be forced by its pressure so closely together, as to intercept its deeper penetration, and its farther progress in a direct line; and particularly this may be the case with iron, and ferruginous bodies." In page 425, reasons are given, to show that these conditions will apply to but few bodies. No hypothesis is introduced here. I had established from observations, experiments, and just analytical reasonings from facts, that an ethereal current exists in the atmosphere, rising in the equatorial regions, and gyrating from East to West in spirals inclined towards the poles, and entering the earth in high latitudes, and thence finding its way again to the torrid zone; and the cause of this current is assigned. Now, few and simple as my principles are, it is evident that the circumstance of the differences in the radii of the spheres of repulsion, would of itself furnish an endless variety of sorts of atoms; an equal variety can be furnished from the differences of their absolute forces; and, besides, their different and varied combinations will produce a multiplied diversity; but from the required conditions, that the ethereal matter must penetrate the body, and penetrate it only to a limited depth, and that the body must be a conductor, &c., we cannot expect the magnetic property to be conspicuous in many bodies, nor in some different states and temperatures of the same body:

that it belongs to more or fewer bodies must be the result of the wise appointment of the great Architect, who formed all things according to rule, to number, weight, and measure. Thus I have assumed nothing here, except what the theory, *à priori*, indicates, and which phenomena establishes, unfolding all the wonders of magnetism! What! may I not employ my principles without having their legitimate application called a *feigned* hypothesis?

I am now called to a new job, introduced thus:—p. 20, "Mr. Exley has invited any gentleman to point out a single fact in any department of natural philosophy which is not in accordance with the theory; I wish, therefore, to submit a few cases," &c. I was sincere and not vaunting in that invitation, and do express it as my desire and wish that any kind fellow-labourer in the field of science would do so if he can; but the *onus* of solving the proposed phenomena cannot be put on my shoulders—it is for the opponent to show that they are not in accordance with the theory. However, as the powers of my theory explain them off-hand, I shall think it no burden, yet I am not legitimately called to perform the work. The first is, indeed, already explained in my Treatise, p. 27, sect. 4, where it is shown how the water expands before reaching the freezing point. The next respects the welding of iron: it is not inconsistent with the theory, but just what it suggests, that bodies should combine at one temperature, rather than at another, as is abundantly shown in the 5th and 6th sections. At certain high temperatures, the atmospherules, extended and diffused by the quantity of caloric, embrace the contiguous atoms, and thus assist the attractions of these more powerful atoms to effect an union; and hence the wonders of chemical combination are unveiled, and the doctrine of definite proportions in all its peculiarities explained, while it remains utterly inexplicable on any other theory. Dr. Turner, in his last edition, has stated it as an ultimate fact. In respect to iron, we may observe it is covered with a sort of varnish when at a welding heat; and thus also glass or sealing wax may be welded at a proper temperature. That a certain quantity of caloric renders the surfaces of many bodies slippery, is shown by many facts; I once proved it by accident, and wish not to repeat the experiment. Having once occasion to take up a bar of iron about twenty lbs. weight, its end being raised from the ground, and not being aware that it was nearly at a red heat, I grasped it tightly, to draw it towards me, but my hand slipped off with a feeling, such as if the bar had been cold oiled glass: not so the subsequent feeling; I plunged my hand into cold water, which was renewed during the day, as it got warm, and this performed the cure, the scar going off in due time. As to Prince Rupert's drops, they are now generally made of black bottle glass, but formerly of window glass. Much difference will arise both from the sort of glass and the manufacture; yet the property belongs, in some degree, to all enamelled glass. When broken in a glass of water, it is not surprising if the vessel be not too strong, that the nearest side is broken, when we contemplate the sudden extrication and burst of a large enclosed body of ethereal matter. That a small alteration of temperature should destroy the magnetism of some bodies, as nickel, is no wonder; the wonder, if any, is, that a body, like iron, should remain magnetic after such a change; but iron and nickel are not the same body. In hardened steel the magnetism ought to take place only in the direction over which the pointed magnet is drawn, as will appear from pp. 55 and 56, Lecture 9, New Theory. Thus have I performed the assigned task as a matter of condescension, not of necessity.

The distinction between theory and hypothesis, I leave philologists to settle; but have great satisfaction to remark, that Mr. Cheverton's distinction confers on my system the title of an unadulterated theory; for he observes, "the term *theory* I would apply to a system whose first principles are ultimate natural facts, or truths, whether self-evident or analytically traced through a course of observation or experiment." Such, precisely, are all my principles, as is fully shown above. Had I introduced Newton's solids and vastly varied attractions, I should certainly have been hypothetical; but now I steer clear of the whirlpools of hypothesis.

Lastly, come the metaphysical disquisitions, with which I shall not meddle, but to clear myself of a doctrine wrongly imputed to me; further than this I am

not implicated in the discussion. It is said, "we have just taken notice of Mr. Exley's doctrine of power without substance." Here I state at once, I hold no such doctrine; I never did, it cannot be inferred from any thing I have said; but the contrary may be proved, if need be, from the Treatise of Physics itself. I have every where considered matter as a substance, of course a material substance, really created, and truly and positively existing. It is allowed on all hands, that what we call force, power, or gravitation, is constantly at work; we are assured of this by the effects: now names cannot alter things; what the thing is which we call by these names, no human being knows. I think, but it is merely matter of opinion, that what we call by these names, is not a property but a substance; yet I rest nothing at all on this: if it is not a substance, then I hold it is the property of some unknown substance co-extended with itself. Which ever way it is, I contend equally for a distinct, really created, material substance; I hold no "doctrine of power without substance;" it cannot be inferred from my work or from my theory. I am, therefore, fairly excused from wading through Mr. Cheverton's metaphysical remarks; they apply not to me or to my theory. And as to Newton's little solids themselves, whoever admits them cannot conceive of them, but as a power of infinite resistance, when supported on the opposite side. But perhaps I have already extended my observations to an undue length.

THOMAS EXLEY.

Bristol, May 2, 1835.

P.S.—It has been said, a philosopher may be rich if he please; but I presume not by writing new theories. Aware of this, I did not write for gain; but yet thought it enough to give my labour. I could not, however, find a bookseller who would undertake the work, but being decided, printed a thousand copies at my own risk, and suffered a loss of 50*l.* This did not deter me from employing my leisure hours for three years to complete the application of my theory to the partly insulated but important subject of optics; and here, again, my success exceeded my expectations; but to show that money was not my object, I published the work at such a price as to leave me 10*l.* minus, should the whole be sold, with the exception of a few copies for friends. Still I complain not, but consider myself well paid; for, as I shall live in heaven, so I shall live on earth as long as it endures.

MR. BABBAGE AND HIS RIVALS.

Sir,—In a late number of your publication, I observe that one of your correspondents claims to be the inventor of a calculating engine which will perform the operations of Multiplication, Division, and even do sums in the Rule of Three. As this is a subject in which I take a considerable interest, I hope I shall be excused if I request a little more information; and first I wish to learn whether this is a self-acting machine, that is, supposing that two numbers are to be multiplied together, is it merely necessary to put them into their proper places, and having adjusted the machine to multiply, to turn the handle until it shall give some signal that the operation is completed? Or when one number is put in as a multiplicand, is it necessary to turn the handle as many times as the number indicated of the multiplier? The question applies equally to Division, and to the Rule of Three, which is a combination of the other two. Also, can it be applied to calculated tables, and if so, how are its results indicated? A machine which when once adjusted to perform an operation requires an assistance from the mind (even the common operation of counting the number of turns of the handle to know when to expect the result) is open to the objection of liability to error. If one turn be omitted, an error is induced into the calculation, and an error made by a machine is the more dangerous because unsuspected. I understand that Mr. Babbage's calculating engine is not liable to these objections, and that one great merit is, that its results are the operation of the machine itself, and engraved upon copper plate with unerring certainty. Has the inventor of this new machine taken any steps to make it public, or to secure the patronage of Government? Matters of this kind are of great public interest, and many valuable inventions perish for want of early attention. I trust, therefore, you will excuse my troubling you on the subject.

I remain, very truly yours,

P. S. C.

METROPOLIS PURE SOFT SPRING-WATER COMPANY.

"Nos monendi causâ pauca esse dicturos."—Cic.

Sir,—An advertisement in this morning's paper announces, that a bill for the incorporation of the above Company has been read a first time in the Commons.

The projectors of this concern proceed upon the ASSUMPTION, that the London basin contains a subterranean lake, and an INEXHAUSTIBLE supply of water.

The result of four trials in the manufactory in which I am engaged, namely, two large wells and two bore-holes, leads me to doubt the correctnes of the ASSUMPTION, "that the supply of water from the main spring is INEXHAUSTIBLE."

For these wells having been constructed at different and at distant periods, between 1810 and the present time, the supply of water, though at first abundant IN EACH of them, has gradually and uniformly diminished IN ALL.

The principal well, nearly a new one, obtains its supply from the whole of the thickness of the quicksand; for the lower end of the bore pipe, which terminates with a ten-inch opening, is bored full of holes for the last thirty feet, and rests upon the face of the chalk. Hence we secure the fullest capabilities of the spring through the whole depth of the quicksand.

This well was pumped for months, night and day, without intermission; and the quantity of water yielded was so great, that the supply was considered to be inexhaustible.

Nevertheless, after a time, the spring grew gradually weaker; and during the last summer (1834) the water was repeatedly drawn down to the suction guard, which is ninety feet from the surface, and the engine was obliged to stop continually, to give time to the spring to replenish the well by infiltration from the quicksand below.

Many of our largest manufacturing establishments are similarly dependent upon the deep springs for their supply of water; and therefore those who are so circumstanced, have a right to ask from what source they are to expect compensation, should this Public Water Company cut off their supply of water, to the complete destruction of their property, by rendering useless their buildings, plant, and utensils, and utterly annihilating their trade, for want of the necessary supply of water to keep them going.

It must be borne in mind, that, to render this new speculation available to the shareholders, the quantity of water to be raised must necessarily be enormous as well as incessant; and when it is mentioned, that after some hours' pumping at one of the wells under my consideration, it lowers the water considerably *in another well three miles distant in a direct line*, and that it requires nearly double the time for the pumps to stand still in the *first* well before the other recovers its level—I trust it will be admitted that the assumption of an INEXHAUSTIBLE supply requires some further elucidation; and it is to be hoped, that before the legislature give their sanction to such an experiment, they will obtain satisfactory proof that they do not hazard thereby the supply essential to the existence of many of the most extensive establishments in and about the metropolis, and involving hundreds of thousands of pounds of capital irrevocably and irremediably sunk.

I remain, Sir,

Your very obedient servant,

A MANUFACTURER.

London, May 4, 1835.

P. S. — Many private individuals have bored holes for their domestic use. A very trifling diminution of the present height of the level of the main spring will render these holes useless, because the bore-holes being small, their pumps could not be lowered to follow the water without considerable expense. Though the public may not be aware of the fact, this is a question in which every housekeeper in and about London is *personally* interested.

WEATHER WISDOM.

Sir,—In the Number of your Magazine for January 24, 1835, a correspondent inquires after some old verses on the weather, one stanza of which, he says, is "if blue the morning sky appear," &c. I am now happy to be able to supply them from a Perpetual Almanack, which was published at Salisbury as far back as 1777.

I am, Sir,

AN OCCASIONAL READER.

March 28, 1835.

If you'd be weather-wise, attend
The plain instructions of a friend,
Who will with certain signs explain
Which promise snow, or hail, or rain:
By which you may, with prudent care,
Against a stormy day prepare.
Since various tokens bounteous Heaven
For mankind's use hath kindly given,
Contemplate with curious eye,
And study how to read the sky.

If blue the morning sky appear,
The day will be serene and clear;
But if red clouds with black prevail,
Expect a storm of rain or hail.

Whene'er the moon, night's silver queen,
Is hid by clouds of darkish green,
And stars, just seen, appear to low'r,
Depend you'll have a heavy show'r.

If in the sun or moon appear
Black spots, although the sky is clear,
Be sure a storm is very near;
And if the beauteous rainbow's seen,
Where mild weather is serene,
Bleak winds will quickly change the scene.

If a prodigious cloud you spy,
Pass quickly on, though very high;
The wind will bring a storm of rain,
And blow a dreadful hurricane.

When the sun's beams are broad and red,
Some boisterous weather you may dread.

Whene'er the evening is serene,
And in the east the rainbow's seen,
The following morning will be fine,
And the bright sun unclouded shine.

When flashing quickly through the sky
You see the forked lightnings fly,
And cannot yet the thunder hear,
Expect fine weather to appear.

When in a clear, but wintry, night,
The stars are twinkling large and bright,
And the black clouds in fleece are lost,
Depend you're threaten'd with a frost.

When winds irregularly blow,
And dingy clouds pass to and fro,
You may expect a deal of snow;
And if you find no morning dew,
Be sure cold weather will ensue.

If round the moon a circle's seen
Of white, and all the sky's serene,
The following day you may divine
Will surely prove exceeding fine.

Whene'er in autumn, or in spring,
A mist the moon doth with it bring,
At noon the sun will bright appear—
The ev'ning be serene and clear.

In winter, store of rain and snow
A spring and summer fine foreshow;
But if too mild the winter's found,
Diseases will in spring abound.

THE PNEUMATIC RAILWAY.

Sir,—In noticing the remarks which you have hazarded upon the Pneumatic Railway in your 612th number, I will not dwell particularly on the obvious charge to which you have subjected yourself, of gross ignorance or of unprovoked malevolence, and will only stop for a moment to admire the temerity of the Editor of the Mechanics' Magazine, in opposing his opinion to the opinions of two of the most eminent men of science in England. Such a display of ignorance may have been made to gratify malevolence, or malevolence may have induced the display. When you announced in a previous number, that the pneumatic railway should have "full justice" done to it, Mr. Hosking, who is professionally interested in that railway, wrote to you, offering to show you our working model, and to afford you such information, as would enable you fully to comprehend the system to which you had promised to do "full justice." I also informed you that, for reasons which I then assigned, all the details of the system could not yet be published. In your answer to Mr. Hosking, you declined his offer, believing, as you said, that you were already in possession of every information requisite to enable you to form a sufficiently accurate estimate of the merits of the *scheme*. If you really possessed such information, you certainly have not given your readers the benefit of it.

Your great objection to the pneumatic railway, is founded on Papin's supposed failure in his experiments to which you have referred. I think that you ought, in candour, to have given credit to the source from which you have derived your information,—"Encyclopædia Britannica," vol. xiv. p. 719. Many of the theories on the science of pneumatics, which were advocated in the older and sometimes even in modern works, are shown by practice to have been founded in error, and are, consequently, at this day, abandoned by all scientific men who are really well informed.

What Papin proposed to do, and failed in effecting, through the imperfection of his means, most probably, is now constantly done, and with the utmost efficiency. Mr. Hague, the ingenious engineer of Cable-street, has succeeded in applying the principle suggested by Papin, and is daily constructing engines which communicate their power by the rarefaction of the air in close tubes, and tubes of small diameter, too, to distances of three, four, five, six, and even seven miles! At the mines of Mr. Brown, near Manchester, Mr. Hague has erected four sets of apparatus, all of which are worked by one steam-engine of seventy-horse power, and one of them being at a distance of three miles from it. Mr. Hague has assured me, and you, or any of your readers, will find it on inquiry, to be strictly correct, that, notwithstanding the smallness of the tubes through which the transmission is made, and the consequent great extent of rubbing surface in them, together with the numberless flexures with which they are laid, *the whole power of the engine is trans-*

mitted to the work, and this at a degree of rarefaction equal to a column of from seven to ten inches of mercury! In fact, the mercury is, in these works, found to stand at exactly the same point at both ends of the same tube, and the transmission of the impulse through the longest of them, which I have already said, is three miles long, is so nearly instantaneous, as to render it difficult, if not impossible, to detect the difference in time. This, however, is not a singular instance. Mr. Hague has erected similar machinery upon the same principle, and acting in the same manner at long distances, in Cornwall and in other parts of England. One set of his apparatus has been in operation in the works of Mr. Foster, at Stourbridge, for the last six years, and without requiring any important repair throughout that period. Not less than a dozen establishments in Holland, and as many as fifty in various parts of Mexico and South America, will testify to the successful application by Mr. Hague, of the means which Papin attempted to use, and failed in effecting. The first mover, I may add, is sometimes wind, sometimes water, and sometimes steam.

Now I do not know whether it was through ignorance or malevolence that Mr. Hague was opposed, but he had to struggle for many years against one or the other, or it may be both, to procure the adoption of his mode of communicating power to a distance by the rarefaction of air within tubes. He had, as I have, to contend against the influence of *quid nuncs*, who can quote exploded fallacies, the ill-will of thwarted officials, and the opposition of interested machinists who procure themselves to be thought mechanical philosophers!

Your other case from the "Encyclopædia Britannica"—that of the attempt to force air through a tube to form a blast at the Eagle Foundry in Wales—is not in point, as that was to act upon a *plenum*, and not with a vacuum, as in the case in question; but it is disposed of, nevertheless, by what I have yet to call your attention to.

You state that "the grand difficulty to be overcome" is the "difficulty of acting on a column of any considerable length, of so thin, subtle, and elastic a fluid as air." The practice of Mr. Hague's apparatus, above referred to, clearly proves that no difficulty exists in acting upon it to a much greater extent, and under much more disadvantageous circumstances, than the pneumatic system of railway requires or imposes by rarefaction; and the practice of gas-lighting as clearly proves that a column of considerable length, of a thinner, more subtle, and more elastic fluid than air can be acted upon to any extent, and to any effect that may be required. To any of your readers who think for themselves, the fallacy—not to say falsehood of your assertions, if they reflect at all upon what is constantly before their eyes, must have been sufficiently obvious. It will be within the recollection of many, and may be known to all, that, when gas-lighting was first proposed for general application, it was declared by the pseudo-philosophers, and Editors of Mechanics' Magazines of the day to be impracticable, because of the difficulty of passing so "thin, subtle, and elastic fluid" as gas in sufficient quantity, and with sufficient velocity through tubes; as it was asserted that the mains must be so large and costly as to make the application unprofitable, even if it were practicable. But during the last twenty-four hours in London alone some millions of cubic feet of gas have been passed through mains and pipes of small diameter, at a distance of many miles from the works at which it is produced, with the greatest required velocity, under a pressure at the works of—what immense force do you suppose, reader? a column of, upon an average, two inches of water! I need hardly refer you from London to Birmingham, but that this latter affords a striking popular example of the practice of passing gas through tubes for long distances. Birmingham is lighted with gas brought from West Bromwich, a distance of seven miles, in mains; and the "thin, subtle, and elastic fluid" is ejected at Birmingham, with nearly the same force as that which is applied to it at West Bromwich.

Now what shall be said of the erudition of the editor of a scientific journal, who is ignorant of the facts herein related? And what shall be said of his candour and honesty, if informed of them he make a garbled mis-statement to repress the enterprise, and injure the property of one who has not called upon the public to aid him in maturing and

exemplifying a useful invention; but has, at his own cost, and by his own exertions, matured and exemplified that which many of the wisest, noblest, and worthiest in England have already recognised as useful and valuable?

Having thus given your readers an opportunity of judging between us upon those matters on which you appear to speak with authority by quoting instances, I am quite willing to trust to their candour and general good sense not to receive your dictum upon the details of the pneumatic system of railway, of which you declined the proffered information, and about which I may assure them you are totally ignorant; for, indeed, I believe that, by the time they have read thus far, they will conclude it to be possible that Professor Faraday and Dr. Lardner may have formed as correct an opinion of a matter they have inquired into, as the editor of the Mechanics' Magazine of that, of the principles and practice of which he is alike ignorant.

I am, Sir,
Your obedient servant,
HENRY PINKUS.

Remarks.

Mr. Pinkus is pleased to admire the "temerity of the Editor of the Mechanics' Magazine, in opposing his opinion to the opinions of two of the most eminent men of science in England," Professor Faraday and Dr. Lardner. But one-half, at least, of this admiration might very well have been spared. Professor Faraday's is no more an opinion in favour of Mr. Pinkus's scheme than is ours. It amounts merely to this, that if you produce a vacuum, or partial vacuum, on one side of an air-tight diaphragm or piston inserted in a hollow cylinder, you will obtain a corresponding pressure on the other—a position which no one acquainted with the first lines of science can contest. But whether this principle of obtaining power can be turned to any *profitable* account—which is the whole matter in dispute—the Professor does not say—indeed, he expressly declines saying. Dr. Lardner, to be sure, is not so scrupulous—he subscribes very unreservedly to all Mr. Pinkus's odd notions on the subject; but though we hold Dr. Lardner's acquirements in considerable respect, and his talents in still more (talents equal, probably, to the achievement of any degree of distinction, if they were but under the guidance of a little more discretion), we must be permitted to say, that his authority, as a man of science, is not *just yet* of so overtopping a description that it should be considered "temerity" in us to differ from him; indeed, if coupled with many more such opinions as the present, it will never be worth any thing.

Mr. Pinkus states truly, that we declined Mr. Hosking's offer of a personal explanation, on the ground that "we were already in possession of every information requisite to enable us to form a sufficiently accurate estimate of the merits of the scheme;" but he adds, not quite so truly, "if you really possessed such information, you certainly have not given your readers the benefit of it." The information which we possessed, and gave our readers the benefit of, consisted, 1st, of Mr. Pinkus's own Prospectus of his scheme; 2d, Dr. Lardner's elaborate commentary upon it; 3d, The Professional Director, Mr. Hosking's, explanatory letter to Professor Faraday; and 4th, Professor Faraday's reply. Now, not only are these the very documents referred to in the advertisements of the "National Pneumatic Railway Association," for evidence of the "practicability and efficiency of the pneumatic system," but they comprehend the whole of the information, neither more nor less, which has yet been given to the public on the subject. If, therefore, we have failed to furnish our readers with information enough on which to form a "sufficiently accurate estimate of the merits of the scheme," the fault lies not with us, but with Mr. Pinkus himself and his friends; and it follows, too, of necessity, that they must be practising a very considerable imposition on the public, in opening a subscription for 200,000*l.*, on the strength of documents, from which, according to this view of the case, no "accurate estimate" of its merits can be formed! Which horn of the dilemma would Mr. Pinkus be pleased to prefer?

But "I also informed you," says Mr. Pinkus, "that, for reasons which I have assigned, *all* the details of the system could not yet be published." Yes, Mr. Pinkus did say something of this sort; but, on the very same morning, advertisements were to be seen in most of the newspapers, soliciting subscriptions to

the "National Pneumatic Railway Association," on the credit of the Prospectus as it stood, and of the opinions of Prof. Faraday and Dr. Lardner. Was it not high time, then, to investigate the worth of those documents? Mr. Pinkus would have liked the money to be subscribed first, and the investigation to come afterwards: but this, though a very pleasant course of proceeding for Mr. Pinkus, was not that which our duty to the public seemed to prescribe to us. Neither could we seriously believe that there were any "details of the system" remaining "to be published" which it was worth waiting for. We looked on Mr. Pinkus's representation to this effect as a mere feint to cover the extreme weakness of his case as it stood. Dr. Lardner commences his opinion by stating, "I have read the *specification* of the patent for the pneumatic railway," and after the *specification*, as every one knows, there can come nothing material, without knocking up the patent.

Mr. Pinkus admits that our statement, with respect to the failure of Papin's similar project, is correct; but he deems us wanting "in candour" in not stating that we derived our information on this head from the "Encyclopædia Britannica." If we had really derived our information from the "Encyclopædia Britannica," we should not have been at all ashamed to acknowledge the obligation; it is as capital authority as one can quote on scientific, as well as most other subjects; and had Mr. Pinkus but read, with due attention, those articles in it which are suitable to his case, we might never have been troubled with his scheme, or with his impertinences in defence of it. (We would refer him, in particular, to the articles, Elements (of physics), Experiment, Modesty, Probity, and Truth.) But it so happens that Mr. Pinkus is quite mistaken in his conjecture; he must, therefore, guess again.

Although we did not give our authority for the case of Papin, — not conceiving any authority to be necessary for a case so well known,—we gave it, at least, entire, and ungarbled. We did not mention the trial only which Papin made, and conceal its failure. We left it to the candour-loving Mr. Pinkus and his favourite referee, Dr. Lardner, to deal with truth after that very candid and honourable fashion.

Mr. Pinkus asserts, that what "Papin proposed to do, and failed in effecting," is "now constantly done, and with the utmost efficiency," by Mr. Hague; and he cites instances by dozens and fifties, in which Mr. H. has erected pneumatic engines that "communicate their power by the rarefaction of the air in close tubes, and tubes of small diameter, too, to distances of three, four, five, six, and even seven miles." Mr. P. is farther pleased to take it for granted that we were "ignorant" of these facts, and to call on the public to mark the prodigious want of "erudition" which this displays. We presume, however, that it will be received as a sufficient proof that Mr. Hague's pneumatic apparatus was not so wholly unknown to us as Mr. Pinkus imagines, that we actually described it in our pages several years ago. (See vol. x. p. 51.) We freely admit that we were not aware of its having been since applied in so many instances, or on so extensive a scale, as Mr. Pinkus represents; but we must, in defence of our "erudition," observe, that most of the facts mentioned by Mr. Pinkus are, probably, as new to the generality of the scientific world, as they are to us. We have never met with them before in any record of the progress of the arts, and do not believe they have been ever before published. Mr. Babbage had evidently no knowledge of them, when writing his "Economy of Machinery and Manufactures;" for, in speaking of the possibility of conveying mechanical power to *a distance*, by the rarefaction of air in tubes, of which he expresses great doubts, the only analogous instance he gives, is that of the Royal Mint, where all the coining presses in one room are worked by a pneumatic apparatus, on a similar principle to Mr. Hague's, constructed by Messrs. Bolton and Watt. Neither does Dr. Lardner appear to have been any better informed with respect to Mr. Hague's performances, since he never once alludes to them, in his Opinion in favour of the Pinkus scheme, though they would have figured there to infinitely greater advantage than his partial citation of Papin's case.

We should like to have better authority than Mr. Pinkus's for what Mr. Hague has done; but even supposing the statements on the subject in the pretend-

ing letter to be all perfectly correct, they fall a very, very great way short of establishing the practicability of the pneumatic railway scheme. The tubes on which Mr. Hague operates, are, as Mr. Pinkus states, "*close* tubes," close at both ends; they are very small tubes, too, (Mr. Pinkus's notion that the *smallness* is a disadvantage, is but another proof of his ignorance); and no greater exhaustion is required to be effected at any one time, than is equivalent to the quantity of atmospheric air admitted at each downward stroke of the piston or pistons, kept in action. Once exhausted, they are (subject to the exception just stated) always exhausted. To infer from so limited an exhausting action as this, that it would be equally practicable to exhaust pipes of nine square feet in area, and five miles long (Mr. Pinkus's proportions!) and that not once, nor twice, nor thrice, a day, but as many times a day as there were carriages sent along the line, is just as reasonable as it would be to infer from the force of Aldgate pump, the possibility of pumping up the great Atlantic.

The analogy between the transmission of gas and the transmission of heavily laden carriages through tubes (or a-top of them) is, if possible, still more fanciful and remote. It would be a waste of words, however, to reason about it; there is manifestly no analogy whatever.

We said, and we still maintain, that while the hempen ropes by which the stationary engines on railways are now worked will do any work (within the limits of their strength) that is assigned to them, "Mr. Pinkus's aereal substitute could not be worked at all." What is the utmost in the way of rarefaction which the stationary steam-engines on Mr. Pinkus's plan could accomplish? Perhaps a third, or possibly half, of a vacuum; any thing approaching to an *entire* vacuum (such is the extreme expansibility of air) is admitted on all hands to be out of the question. Dr. Lardner says, that a vacuum of one fifteenth, = to a fall of two miles in a barometric gauge, would suffice for all working purposes. But be the degree of vacuum required in the railway tube or tunnel what it may—a half, a third, or a fifteenth—it is certain that it will require a *complete* vacuum in the steam cylinder to produce it. In any event, and under all circumstances, a *complete* vacuum must be employed to produce *a very partial* one. Now, exactly in proportion to the degree of vacuum produced in the railway tubes, must its working capabilities be. If, as our intelligent correspondent, Mr. Berry, has pointed out, (see last No., p. 89.) the exhaustion is carried no further than Dr. Lardner proposes, that is, a fifteenth, then will the carriage be propelled no further than a fifteenth of the entire length of the tube; or, if the exhaustion is pushed as high as a third, or a half, there will still be two-thirds, or a half, of the distance left untraversed. Instead of the railway carriages accomplishing five miles at a time, as, according to Mr. Pinkus's calculations, they ought to do, they would be found sticking fast at one, two, and three. You may multiply the number of stationary engines as much as you please, the result would still be the same; the impulsive or efficient power obtained would always be something less than the steam power employed to produce it. Nothing, in fact, short of exhausting the tunnel completely, every time a load was passed over it, could suffice to realize Mr. Pinkus's scheme, and that—within economical limits, at least—is a physical impossibility.

We laughed at the peculiar claim set up by Mr. Pinkus to the "power of surmounting acclivities;" but we gather from some communications which have been addressed to us on this point, that we had not pointed out with sufficient clearness in what its absurdity consists. Let us revert to it, then, for a moment, before we take our leave of the subject. "The first striking feature in this, the pneumatic system of railway," says Mr. Pinkus, in his Prospectus, "is the power it possesses of overcoming acclivities *insurmountable by the locomotive steam-engine, and without diminution of speed.*" Now, the utmost pressure that can be exerted under the pneumatic system behind the impelling diaphragm, is the pressure of something less than *one* atmosphere, while locomotive steam-engines may be worked at many atmospheres; and it is also certain that, let the pressure be what it may, *gravity* must of necessity operate to the diminution of *speed*. Is it not, then, extremely absurd in Mr. Pinkus to pretend to be able to do more with a fraction of one atmosphere than others can do with two, three, or half a dozen atmospheres?—Highly ridiculous in him to

imagine that a carriage, propelled by any power whatever, can act independently of gravity—go as fast up hill as on a level—with a load as without one? Not only exceedingly ignorant, but exceedingly quackish?

Were even Mr. Pinkus's scheme as correct in point of principle as it is erroneous, it must be rejected, on the score of economy alone. For, prodigious as his pretensions on this head are, there is not a particle of truth or feasibility in them. We are spared, however, the trouble of entering into this branch of the subject, by the letter, from a respectable correspondent, which we subjoin; we leave it in good hands.

Mr. Pinkus complains of the tendency of our observations to "injure" him in his "property." We are always sorry when our duty, as public journalists, obliges us to pursue a course that may be attended with individual injury; but, in the present case, our sorrow is greatly lessened by reflection on the extent of pecuniary mischief to others, which our exposure of the folly of Mr. Pinkus's scheme may possibly be the means of preventing. Mr. Pinkus boasts that "many of the wisest, noblest, and worthiest in England have already recognised" it to be "useful and valuable;" but, notwithstanding his amazing good luck in this respect, it appears from the daily advertisements in the newspapers of the "National Pneumatic Association," that the necessity still remains of appealing to the commoner portions of the community for those "sinews of war," without which the project must, in spite of the flattering opinion entertained of it by so many wise, and noble, and worthy personages, fall to the ground. The total sum proposed to be raised is 200,000*l*., in 10,000 shares of 20*l*. each; and of this sum it is probable that by far the larger portion has still to be subscribed. If, therefore, we can but be the humble instruments of stopping this nonsensical affair where it is, we shall make two or three thousand yet unhooked (though perhaps eyeing and nibbling) holders of spare cash, our everlasting debtors. Mr. Henry Pinkus will be a loser, but the community at large exceeding gainers.

As to the personal civilities which Mr. Pinkus has heaped upon us, in return for the pains we have taken to set his merits in a fair light before the public, we must leave such of them as have not been honoured with special notice in the preceding remarks, to speak for themselves. We did not labour for his praise, and are not at all touched by his reproaches. That we should be abused by Mr. Pinkus and his partisans, is no more than we expected; pretenders and speculators, when baffled and exposed, are always abusive.

THE PNEUMATIC RAILWAY FINANCIALLY CONSIDERED.

Sir,—Will you allow me, through the medium of your excellent Magazine, to suggest to the public (at least to those who are not already aware of it), the total fallacy of the financial representations upon which the "National Pneumatic Railway Association" have taken their stand.

Your scientific objections to the scheme, Mr. Editor, would at once be sufficient, to a mechanical man, to confute their assertions; but the public generally require to be convinced by comparisons of expense, that there is no advantage to be obtained from it. This task is, in the present instance, by no means a difficult one; were it even to prove that, instead of being a benefit, it will be productive of total ruin to all those concerned in it—excepting always the professional gentlemen, promoters of the plan, &c. &c.

The Prospectus of the Association goes such lengths as broadly to assert "that, by the improved system, a line of road may be constructed for, at most, two-thirds, and in some cases for one-half, the expense incurred by the common system, &c.

The Professional Director may take his choice of a wilful imposition upon the public; or, what in his case is scarcely less pardonable, a most gross error in calculation. Tredgold has stated, in his Essay on Railroads (p. 141), that the average expense per mile of a double line of railway, as taken from railroads constructed, is, as nearly as possible, 4,000*l*. Now, two-thirds of this is about 2,700*l*., a sum per mile, which, by the showing of the Professional Director, is to cover all their expenses. Well, their pipes are to be 40 inches diameter, and for the requisite strength, say 1½ thick—which will not be too thick, as there is a valvular opening through its whole length

—the weight of this pipe per mile, for a single line only, will amount to 1.160 tons!! This, at 10*l.* per ton = 11,600*l.* per mile; or 23,200*l.* per mile for a double line, in the cost of the bare material.

It is not necessary to trouble you any further with a detailed estimate; but I am prepared to prove, that the *contingent* expenses upon a double line (a few of the principal of which are, boring pipes, labour in joints, flanges, &c.; digging out foundations, setting in concrete, labour in fixing, cost of ground, stationary engine and houses, railroad carriages, &c. &c.), will not amount to less than 35,000*l.* per mile; and as the capital of the Company is stated to be only 200,000*l.*, their job will only extend to about 3½ miles! A *national* undertaking, truly, and one that will, without doubt, in their own language, "induce the proprietors of all the ordinary railroads and canals in this country to avail themselves of its advantages, [and thus *all* become tributary to the Association," &c. &c.

For the sake of Doctors Faraday and Lardner, it is really to be hoped that the scheme will be dropped without the question being raised of its practicability, as there is great reason to believe that they have been, in some manner, drawn into the affair without a perfect knowledge of the use to which their names were to be applied.

I am, Sir, &c.

W. M. P.

46, Lower Belgrave-place,
May 14, 1835.

CLARK'S BLOWERS.

Sir,—I have just had one of Clark's Blowers described in the Mech. Mag., and though I don't find that they will make a good fire in "*one* minute," yet they perform so satisfactorily, that I think there never ought to be another pair of bellows made. The fly was twelve inches in diameter, and before the spout was fixed on, I found that the air was not drawn off in a tangent, but had a very sensible curve; so I made the spout as near the curve as possible, as it is very obvious that there should be no more obstruction than is unavoidable, either from friction or from making the spout small, as it is quantity, and not intensity, that is wanted. I also find it advantageous to have a bent spout to take off and on, as the front is not always the best place to blow a fire, and sometimes a few turns under the grate will do more than three times the number in the front. It will work with either two, four, or six flies; but I have not ascertained which is the most advantageous number, or whether it would not be advisable to incline the flies from the line of motion.

Might not an instrument of this sort be used as a substitute for the air-pump? Suppose one to be made strong, and to work a collar of leathers, and to have the feed-pipe to fix into a well thirty feet deep. If it were thus put in rapid motion by means of a small pulley, and a very large fly wheel from high, would the water rise? This is an important question, as there are so many stills and boilers now made on the vacuum principle, for if it would only raise the water fifteen feet high, a large still might have half the air driven out of it.

Yours, &c.

G. DAKIN.

Dereham, March 24, 1835.

NOTES AND NOTICES.

Captain Henry Kater.—The scientific world has to deplore the loss of Captain Henry Kater, whose various labours in mathematical and physical researches, for nearly half a century, have greatly enlarged the bounds of experimental science. He was born at Bristol, April 16, 1777; and in 1794 obtained a commission in the 12th regt. of Foot, then stationed in India. During the following year he was engaged in the trigonometrical survey of India under Colonel Lambton, and contributed greatly to the success of that stupendous undertaking. About the same time he constructed a peculiarly sensible hygrometer, and published a description of it in the Asiatic Researches. His unremitted study during seven years in a hot climate greatly injured his constitution, and was the cause of the ill state of health under which he suffered to the close of his life. He went on half-pay in 1814, from which period his life was wholly devoted to science. His trigonometrical operations, his experiments for determining the length of a pendulum beating seconds, and his labours for constructing standards of weights and measures, are well known; they combined patient industry, minute observation, and mechanical skill, with high powers of reasoning. Most of the learned societies in Great Britain and on the Continent, testified their sense of the value of Captain Kater's services, by enrolling him amongst their members. The Emperor of Russia employed him to construct standards for the weights and measures of his dominions, and was so pleased with the execution of them, that he presented him with the order of St. Anne and a diamond snuff-box. The even tenor of Capt. Kater's life was rarely interrupted. The loss of his daughter, who fell a victim to her ardour for science in 1827, was the severest affliction by which he was visited. She died in her seventeenth year, after having displayed mathematical powers of a high order, and a love of science that even increasing physical weakness could not destroy. Most of Capt Kater's publications appeared in the Philosophical Transactions, to which he was a very constant contributor.—*Athenæum.*

The Birmingham Town-Hall.—In the last number of the Architectural Magazine there is a very spirited and manly letter from Mr. Hansom, the architect (now of Hinckley), pointing out two or three rather serious mistakes in the account which was given, in that journal, of the authorship of the design of the Birmingham Town-hall, and transferred from it to our pages. "It happens, fortunately for me," says Mr. Hansom, "that, in the declaration I am about to make, there needs scarcely a single reservation; and when I state that the design of the Town-hall is as much mine as St. Paul's Cathedral was that of Sir Christopher Wren, I state solemnly and sacredly the truth. It is quite true that the site of the building, and the height, length, and breadth of the hall were prescribed; and, what I lament, the tasteless and absurd galleries which permanently disfigure it. It is also true, that, at the suggestion of a gentleman connected with the musical arrangements, an alteration was made in the interior decoration or finish of the walls, by substituting Corinthian pilasters and cornices, for an adaptation of the Ionic antæ, which I had designed; but, with these exceptions, I can take up the plans, elevations, sections, and working drawings, and declare that, line for line, there is not one that can be pointed out as the suggestion, or that was based upon the idea or imagination of any living being besides myself." Further: "Many of your readers will recollect that the competition for the Fishmongers'-hall did not take place till nearly a twelvemonth *after* that for the Town-hall at Birmingham; they will be astonished, therefore, as I was, with the sentense in the article from which I quote, which states that the design for the latter building 'was one jointly produced by Messrs. Hansom and Welch two years *before*, and which was intended for the Fishmongers'-hall, London!' The designs that were made for the Fishmongers'-hall (but not adopted), purporting to be these of Messrs. Hansom and Welch, were made in the month of December, 1832, by my own hand, from my own sketches, and were the result of my own studies, equally with those of the Birmingham Town-hall." Mr. Hansom ought to be better known than he is. The designer of so noble a structure as the Birmingham Town hall has surely a higher destiny in reserve for him, than any which a small and remote town like Hinckley can offer. The whole country suffers, when men of Mr. Hansom's stamp are suffered to waste their energies on any other than works of the first national importance.

Metropolis Spring-Water Company.—We believe, with C. B. G., that this is a very absurd and delusive project; but, if we are not misinformed, it is already *in articulo mortis.* We insert, in this week's Number, a most convincing letter on the subject, from an eminent "Manufacturer;" and may also refer to Mr. Matthews's just published work, "Hydraulia" (to which we shall pay our respects soon), for some very forcible illustrations of the folly of the scheme.

One of the last Numbers of the Penny Cyclopædia contains an article on the "Bear," in which there is one extract in Latin, and several, of some length, in French, without an attempt at translation! Do the worthy members of the Useful Knowledge Society imagine that these languages are now so universally diffused among the working classes—for whom they stated "The Penny Cyclopædia" to be intended—that they are the same to them as their own mother tongue? If not, why fill the columns of their work with matter unintelligible to the mass of its readers? Strange to relate, they still think it expedient to furnish a translation to quotations in *Greek.*

Gravesend Railway.—It is understood that the project of a railway from Greenwich to Gravesend is at present at a stand, in consequence of the Princess Sophia, as Ranger of Greenwich Park, having declared herself hostile to the plan for carrying it in that direction. It is much to be questioned whether the shareholders ought not to be obliged to her Royal Highness for throwing cold water on the scheme, since the probability of profit resulting from its operation, with such a formidable rival as the Thames all the way, seems to be extremely small.

The Brussels and Mechlin Railway was opened on the 6th of May, in the presence of an immense concourse of spectators. At a quarter past twelve o'clock, the King being at the station, near the Boulevards, to witness the ceremony, the departure of the steam-carriage train was announced by a salute of artillery. Immediately three files of ten carriages, each carrying nearly a thousand persons, began to move, drawn by the Flèche, the Stephenson, and the Elephant. The passage from Brussels to Mechlin occupied fifty-three minutes. On their return the Elephant took in tow all the thirty carriages that had been drawn by the three locomotives, and would probably have reached Brussels in half an hour, had it not been obliged to stop at Vilvorde for a fresh supply of water. In the evening the Minister of the Interior gave a public dinner to 200 of the principal persons, natives and foreigners, who were present at the ceremony.—*Brussels paper.*

Mr. Stephenson has been appointed a Knight of the Order of Leopold.—*Ibid.*

New Description of Cabriolet.—A vehicle of this description, hung upon a new principle, has just been brought out at Paris, and is now all the rage there. Its advantages over the old one are greater lightness, easiness, and cheapness. The principal difference is in the mode of suspending the body. In the patent cab the square frame is dispensed with, and the substituted one may be best described by likening it to a hay-fork, supposing the horse to work within the prongs, and the body to be built upon springs upon the handle, which is laid across the axletree. By the balancing of the body upon a single perch, the movements backward, forward, and laterally, are much easier, and the whole is rendered lighter. It of course requires good screwing at the point where all the springs radiate upon the beam of the scale, to maintain the body in its proper position, but as constructed, it is said to answer well. The principle of resting bodies on a point in the middle, is not new in the construction of four-wheel carriages.—*Morning Herald.*

Communications received from Enort—Rev. R. Carey—Mr. Maynard—Mr. Baddeley—M. N.—A Young Chemist—Bergein—A Radio et Pulvere.

The Supplement to our last Volume, containing Titles, Index, &c., with a Portrait, on Steel, of Samuel Clegg, Esq., C. E., is now published, Price 6*d.*; also the Volume complete, in boards, Price 8*s.* 6*d.*

Our Publisher will give One Shilling and Sixpence for copies of the Supplement to Vol. IX.

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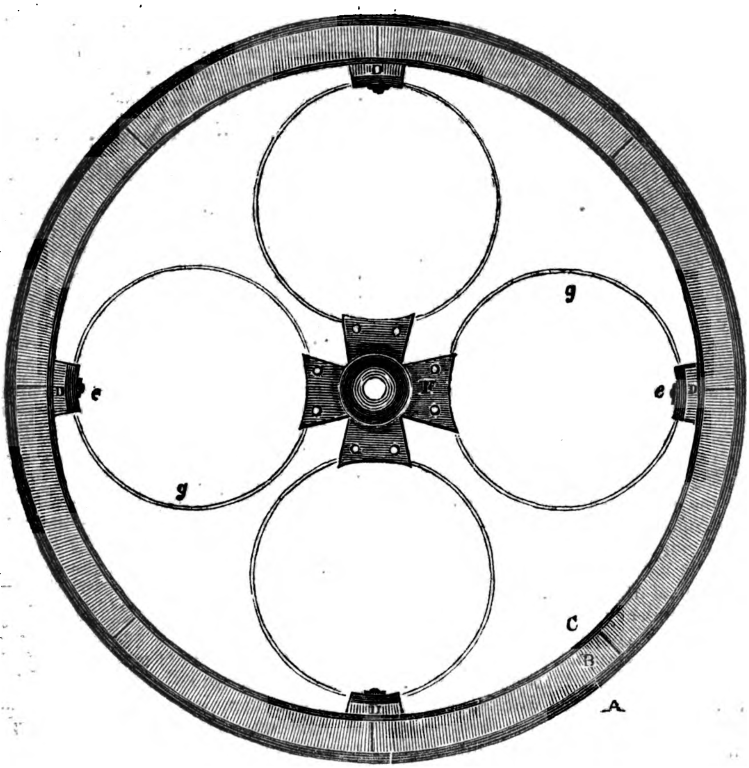
ADAMS' PATENT CIRCULAR SPRING WHEELS.

Fig. 1.



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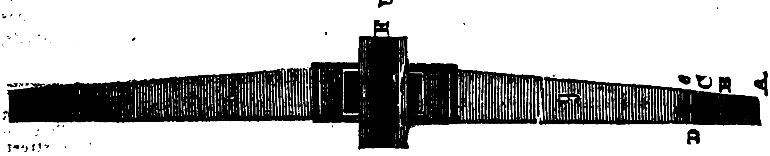


ADAMS' CIRCULAR SPRING WHEELS.

"Break all the spokes, * * * * *
And bowl the round nave down."

It has long been a desideratum amongst mechanicians, to accomplish the task of constructing a wheel for carriages intended to convey persons and goods over rough roads, which, while it should possess sufficient strength fitly disposed in its several parts to resist breakage, unsteadiness, or any permanent alteration of form, from any of the ordinary shocks or violence to which it might be subjected, should yet possess the property of elasticity to such a degree, as to intercept and materially diminish the concussion caused by the periphery rolling over obstacles during its revolution; and thus either prevent the concussion from extending its effects to the axis round which the wheel might revolve, or to lessen it so much that the effects might be comparatively innocuous. It must, of course, be necessary that the elastic power should be placed between the periphery and the axis, without in any way diminishing the roundness or altering the circular form of the periphery—which circumstance would tend materially to increase the rolling friction of the wheel: wherefore the only mode in which elasticity can be made available, must be by enabling the axis to depart sufficiently from the exact centre of the periphery where concussion takes place—to which exact centre the elastic force pressing equally in various opposite directions in the plane of the wheel, should have a constant tendency to restore it, when the effect of the concussion might cease. The advantages attendant upon a wheel so constructed are several and obvious.

1st, In ordinary sized wheels, used for a cart without springs, the concussion from the road is driven in a direct line along the spokes to the axis; and this concussion, constantly kept up as the wheel revolves, serves materially to increase the weight of draught, by forcing out the oil or grease, and bringing the rubbing surfaces of the axis and axis-box in close contact, to the increase of friction. This disadvantage would be removed entirely, or very materially lessened, by the use of an elastic wheel.

2d, In carriages with rigid wheels, to which the axis is attached by means of a horizontal spring bearing on the axis, the concussion is diminished, by its uniform bearing upwards; still it is but slightly, inasmuch as the momentum of the concussion passes directly along the rigid spokes to the axis; and, moreover, the relief which the spring affords is only in a vertical direction; in which direction the greatest amount of the momentum of concussion does not pass, but in a direction more inclining towards the line of progress as the wheel revolves. This disadvantage would be materially lessened by an efficient elastic wheel, inasmuch as the elasticity being in a circle all round the axis, would avail both against vertical and horizontal obstacles or inequalities.

3d, It is well known that the force requisite to move a carriage at first starting is greater than that required to keep motion up. The reason of this is, that momentum is required in proportion to the rapidity of the motion. Wherefore, every obstacle or inequality which the wheel encounters as it revolves, has a tendency to check the momentum, and render the draught power necessary to move the carriage onwards, nearer in amount to that which was originally required to move it from a state of rest; because the concussion in the line of progress is nearly in direct opposition to the momentum, and serves to neutralise it. An efficient elastic wheel would be found to receive the concussion on its periphery; but as it would not carry it, or would carry it with a diminished force, to the axis, the momentum of the superincumbent framework, to which the draught power is attached, would scarcely be acted on by it.

4th, The wheels of carriages are subject to considerable concussion in a lateral direction, lengthwise of the axis. A rigid wheel, under such concussion, transmits the concussion almost unbroken to the carriage, to the annoyance of the passengers, and with a tendency to derange the framework. But an efficient elastic wheel would possess a small portion of lateral elasticity, sufficient to diminish the violence of the concussion, and yield greater ease of motion.

5th, An elastic wheel, by its tendency to elude concussion rather than to resist it, will be less liable to be broken or strained than one which is rigid, and consequently its total durability is likely to

be much greater. Wooden wheels, by reason of their property of elasticity, are less liable to break than those of iron.

Wheels are to a carriage, what legs are to a human being—the instruments of locomotion. A man who loses an elastic leg, of bone, muscle, and ligaments, may have a wooden one to replace it; but he will find that the act of walking with the wooden one is a much ruder and less perfect process than with the one of bone and muscle; concussion, and the labour of surmounting or avoiding obstacles, will render the man's progress much slower. And it seems clear, that the property of elasticity in a wheel gives it a similar advantage over a rigid one, that the natural leg does over the artificial one, though to a less extent; inasmuch as the mechanical contrivance of art must be inferior to the more perfect processes of nature. Ships which are of rigid construction, are found to make a slower progress through the water than such as are slightly flexible; and in row-boats the quality of flexibility is indispensable to swiftness: the reason is, that the flexible boat, as it advances, adapts itself, by its sinuosity, to the slight movements and currents of the water, which it eludes instead of resisting. The movement of a fish through the water is an illustration of the same principle; and, by a parity of reasoning, a carriage with elastic wheels avoids, by its yielding properties, many obstacles over which rigid wheels would require to be impelled by a greater exertion of power.

The general conviction of the advantages to be obtained by using elastic wheels, has led to many attempts at their construction, but hitherto without any efficient result. One mode which was attempted, was by arranging a number of pointed double elliptic steel springs in radiating lines from a nave to a periphery. To guard against the lateral action or leverage, these springs were doubled in number, and arranged at a lateral angle with the length of the nave each way. Even supposing such a wheel to be efficient, the expense of its manufacture would have precluded any extensive use of it; but the action was too imperfect, to allow much use without destruction of its parts. The elasticity of the springs could only be brought into action in the direction of the length of the ellipses, either by extension or compression; consequently the action could only be in a line diametrically across the wheel in one direction at a time: thus but few of the springs would be in action at one time, and that in a most imperfect mode, viz., in the length of a very long and narrow ellipse. The principle of an efficient spring wheel should be, that the elasticity should be alike at all parts of the circumference, and that no one part should act without the whole—that every spring should sympathise equally with the rest, from whatever direction a concussion might come. A wheel like that just described could not comply with this condition, and therefore such a wheel could not be durable. Another mode of forming a spring wheel was by making steel blades or ribbands, in a sinuous or undulating curve, and forming them in radiating lines from a nave to a periphery, doubling them in the same manner as described in the elliptic spring wheel, to resist the lateral action or leverage. Supposing this wheel to be true and well made, the action would be more perfect than the former one; but the making of such springs all to stand their work equally well, and the needful accuracy of fixing them, would involve an expense too great for any extensive use; and after all, the action would be of that kind very likely to break the springs with a violent concussion. A third plan which has been proposed, but, we believe, never put in practice, is a small wheel placed within the circumference of a solid rigid ring of much larger diameter, the space between being supplied with several small hoops of ribband steel with open ends, put in with compression, so as to leave them free, to enlarge or diminish their diameter when in action. These hoops were to be kept in their places by flanged segmental cavities adapted to their size in both wheel and ring, being otherwise unconfined by any fastening. The disadvantages of this form of wheel are many. First, its extreme want of elastic firmness; next, its want of universal action, being calculated only to act by compression on the springs below, and not by extension of the springs above. A great defect would be, that while the weight were pressing on the

lower springs, the elastic action of the upper springs would be directed, not to alleviate, but to increase the weight. In action, this wheel would be impracticable; for stones and dirt would lodge in the centres with the springs, clog their action, and break them. But one useful thing they contain, viz., the germ of the only sort of spring which can be effectively applied to spring-wheels—the circle. The wheel itself is a circle continually revolving, and springs intended to have an equal action in that wheel, whatever side be uppermost, must be circles likewise. No other form can be of universal action, in the place of the wheel; no other form will yield extensibility and compressibility in every direction in rapid succession, each tending alike to restore the nave to the exact centre of the periphery, as the momentary action of concussion passes away.

Mr. William Adams, a partner in the firm of Hobson and Co., of Long-acre, has marked this essential principle, and has had the perseverance to work it out in detail, so as to lay it before the public in a practicable form. The leading features of his invention are four hoops of broad steel plate, properly tempered, the ends of the hoops being overlapped and rivetted together, so that each hoop may be solid, by which means it will resist and yield equally, both by extension and compression. These hoops are affixed firmly at equal distances in the interior of a rigid circular rim, which forms the periphery of the wheel. This circular rim is made rigid by its peculiar mode of construction. An inner iron, or steel tire, of less substance than the outer one, is surrounded by a circle of wooden felloes, accurately fitted to the inner tire, and also with their ends accurately fitted to each other like a barrel arch, the lines of the joints meeting in the centre of the circle. Around this circle of felloes, so fitted, the outer tire is shrunk on hot, as usual, and all three thicknesses are rivetted together. In calling this a rigid rim, we do not mean that it is rigid like an iron casting (for if it were so, it would not stand its work, but be liable to break, as cast iron wheels do); but that, while it possesses a slight portion of elasticity sufficient to prevent breakage, it is also sufficiently strong to prevent any permanent alteration of its form by any ordinary concussion to which it may be subjected. To this rim the four hoop springs are firmly bolted, but do not in any material manner contribute to strengthen it. The springs serve as elastic legs; the rim serves as a foot to guide the steps they make in revolving. Wheelwrights call the act of putting a tire on a wheel —"shoeing it."

The nave of this wheel is made of iron flange plates, fitted to the axis-box, and reinforced by wood blockings. The flange plates are made in the form of a Maltese cross, and to the arms of this cross the hoop springs are firmly fixed, each with four clip bolts and nuts, without making holes in the spring; and this mode is found to ensure sufficient lateral strength to resist the central leverage of the wheel. The springs are tapered in width towards the circumference, in order to give the greatest elasticity towards the point of concussion. The axis-box is so contrived that it will carry a very large magazine of oil in actual contact with the axis, and the wheel is therefore likely to travel considerably farther without requiring fresh oil than any other kind, more especially as the elastic action removes the extra friction arising from concussion. Most oil axes are fed with oil by a capillary or pumping action. This action is liable to be disturbed from many causes, and if disturbed, the wheel will become fast on the axis by heating. But an axis in actual contact with the oil cannot be liable to these accidents.

One of the first considerations which struck us was, that a wheel with so much metal in it must necessarily be very heavy; but this proves not to be the fact. The peculiar action and combination of the springs being such, that all mutually assist and are dependant on each other, the thickness of the plates is necessarily so much reduced below the ordinary standard of spring plates, that great lightness is combined with great strength. Thus a pair of these spring wheels are found to be just so much heavier than ordinary wooden ones, as the weight of the inner tire amounts to. But as the axes used in ordinary rigid wheels are made much heavier than is needful, for the weight they carry, in order to resist extraordi-

nary concussion, so the axes of the spring wheels, not being subject to the same amount of concussion, may be reduced in weight, in order partly to compensate for the tire; and the surplus weight being thus placed at the circumference of the wheel, instead of on the axis bearing, the friction will be reduced: and, in addition to this, the freedom from concussion, consequent on the use of the elastic wheel, will enable a saving to be made in the weight and number of the carriage-body springs; and thus a farther amount of weight, and consequently of friction, will be removed from the axis-bearing. In the construction of a wheel-carriage, the weight, as well as the strength, of the wheels should always bear a certain proportion to the superincumbent weight, or the centre of gravity may be too high, a disadvantage nearly as great in a carriage as in a ship. A wheel may be too light as well as too heavy, and the former defect is the greatest. The former is a defect of principle, and is dangerous: the latter can only make a slight difference in the draught by additional weight, and not by additional friction on the axis-bearing; and, at a considerable speed, the weight of the heavy wheel acts with momentum like a fly-wheel.

Mr. Adams's elastic wheel is light and elegant in its appearance, and apparently well adapted for pleasure carriages on common roads; but there is a still more extensive purpose for it to serve—we allude to the railroads, whose increasing number, and probable universality, render economy in the mode of transport a most important object. It appears, from Mr. Wood's statements, that the difference of wear and tear between carriages with springs and carriages without, on railroads, is as one-quarter to one-half. The springs used in railroad carriages are very short, and have little play, and that only in a vertical line, which is not the line of concussion. At rapid speed the necessity for elasticity increases in compound progression. The speed used on railroads would tear a carriage to pieces on a common road. A small pebble, or a trifling inequality in the joint of a rail, at a high speed, gives a violent shock, and the momentum of each succeeding wheel, in a long train of carriages, like repeated rapid blows of a hammer, at each action increases the weakness of a loose rail, and ultimately breaks it, or renders it useless. As the elasticity of the spring-wheel acts in a direct line of concussion, both rails and carriages would be saved from it, and the total amount of friction considerably diminished. In the ordinary rigid wheels used on railroads there is occasionally a tendency, when not running in an exactly straight line, for the side of the flange which guides them to mount the rail, and thus overturn the carriage. It seems to us that the lateral elasticity of Mr. Adams's wheel would have a tendency to prevent this kind of accident; for the flange not revolving in a rigid plane, would slip downwards from the rail, as fast as a grinding contact might give it a tendency to mount, and the lateral elastic action would then tend to restore the track of the wheels to the proper position.

An elastic wheel possesses another advantage over a rigid one, in case of the defective construction incident to all wheels, viz., the absence of roundness, i. e. excentricity of orbit. A rigid wheel of this form must necessarily move with much friction; but the elasticity of a spring-wheel would tend to correct this defect, by yielding where there was the necessity during its revolution.

For ordinary weights, the springs are made in single plates, by which means they may be effectually preserved from rust; but for heavy carriages and engines, the inventor proposes to multiply the number of plates in the same mode as other carriage springs.

Fig. 1 is a side elevation of the wheel.

Fig. 2 is the cross section.

A, is the outer tire.

B, the felloes.

C, the inner tire.

D, blocks to bed the springs on the rim.

e, the clips to fix the blocks down the springs on the rim.

F, the central Maltese cross and axis-box.

g, the circular springs.

By the simplicity of construction, if a spring should break, it may be removed and re-placed, without taking a carriage off the road, in a few minutes. The railroad central nave is of still simpler construction than that for the common road.

THE METROPOLIS SPRING-WATER COMPANY PROJECT.

Sir,—The expectation expressed in your Magazine of this day, that the Metropolis Spring-Water Company was *in articulo mortis*, is, I fear, unfounded—the Bill for its establishment having been read a first time in the House of Commons, and ordered to be read a second.*

Your correspondent, "A Manufacturer," has stated some of the objections which exist to this Bill, upon the ground of the Company being unable probably to derive a sufficient supply of water from the source they contemplate; but there is another objection to the scheme which will doubtless prove fatal to it. The Company are actually asking from the Legislature the exclusive privilege for a term of years of supplying the metropolis with water from the soft springs of the London basin: of course, if there should appear any, the least probability of this Bill passing, a tolerably strong and effective opposition may be expected to this portion of it, which is, in fact, about the most monstrous proposition that has been submitted to the Legislature for years.

I must confess, that I do not participate in the fears expressed by "A Manufacturer" of the inability of the vast storehouse of water beneath the London blue clay, to afford a sufficiently copious supply to the metropolis. If a large shaft, say 50 feet in diameter, be sank to the requisite depth, that is, to the chalk strata, there is the testimony of every previous experiment, to show that the quantity of water to be derived will be almost boundless. There are many factories in and about London which consume 200 or 300 gallons per minute, and obtain an ample supply from wells sank only to what is termed the first main-spring, or even from a 6 in. or 8 in. bore, of that depth, say from 100 to 150 feet deep; and this, too, although the quantity now taken from that source is most enormous, as almost every extensive consumer of water, in consequence of the exorbitant charges of the Companies, possesses a well of this description: in some instances, as much as 500 gallons, or even more, per minute. Now, as 100 gallons per day, is as much or more than the various water-works deliver to their customers,* we have here one small well which would supply 7200 houses. It is true, that as greater quantities of water are required, the water in the wells sink considerably, but still they are never drawn dry; and in my opinion can never be drawn dry, unless the Thames and other rivers, whose springs gush out from the face of the chalk formation upon which the blue clay of the London basin rests, be drawn dry too. Mechanical obstructions may sometimes impede the supply, but this can never happen from any deficiency of the fluid itself. In fact, the main question appears to be, not whether it is possible to draw an almost inexhaustible supply from the contemplated source, but whether, if the project is carried into execution, it will ever yield any thing like a reasonable return for the capital invested.

There appears to be a considerable want of practical information upon the subject even among the agents and projectors of the Metropolis Spring-Water Company. They seem to suppose that one continuous lake of water exists beneath the blue clay upon which London stands; but a little inquiry would have informed them, that water exists at different depths in the blue clay; that from some of the lower springs the water will rise to a greater height than from the one which is nearest to the surface, and much more copiously; that over the face of the chalk which exists at a greater depth than the blue clay, which is, in fact, the next succeeding stratum, a very large stream of pure water appears to be continually flowing; and that it is from this source, far beneath that which they describe in their prospectus, the large supply of water required for some businesses is frequently obtained.

The main objection to the success of the Metropolis Spring-Water Scheme, will arise from the enormous expense which will be required to raise the water from the shaft to the level of the present reservoirs of the different companies. It is probable that every gallon of water will have to be pumped at least 60 feet, to elevate it to a level with the Thames; for

* This notwithstanding, we believe our information will be found quite correct. Much show of business there will of course be, till the deposit money in hand is worked out, but with that—an end.—Ed. M. M.

* This is a mistake. The average supply of the New River Company is 211 gallons; of the Chelsea Works, 168 gallons; the West Middlesex, 185 gallons; Grand Junction, 350 gallons. See *Matthew's Hydraulia*.—Ed. M. M.

though it is probable that a shaft sunk down to the chalk would, if left in a state of rest, attain an equal height with the Thames, yet when it is pumped continually it will be much lowered: not that the source will be exhausted, but that the water having to force its way from the source through quicksands and other obstructions, will of course not flow with sufficient freedom to maintain a level with it; when left to itself, the water will again rise to its former height, after a lapse of a few hours; but it is not possible to draw a large supply without raising it from great depths. We may safely estimate, that the average pumping of the Company will be to the height of the New River Head, at Pentonville, that is, 80 feet above the level of the Thames; which added to the supposed depth in the shaft below the Thames, will make 140 feet: so that it will require 140,000 lbs. to be raised 1 foot high every day, for the supply of every house in the metropolis. It will be for the engineers of the Company to state at what sum they estimate the expense of the power thus required; and it will be for the public to consider, before they purchase shares in the Company, what reasonable prospect there can be of their receiving an adequate interest for their capital.

At the same time that there does exist strong doubts with respect to the prosperity of a company formed for taking water upon a large scale from the main springs, yet it is possible that companies upon a narrower plan for the supply of small districts might prove successful. They would be able to obtain the requisite quantity of water without any great labour or expense, and they would be able to avoid the necessity of raising the water to so great a height as is necessary in larger works, because, in consequence of the comparative nearness of the reservoir to the consumers, the friction upon the pipes would be little, and 70 or 80 feet of pumping might thus be spared. The New River Company are continually obliged to expend 50 or 60 feet of power to overcome the friction upon their pipes, and they would be able to prevent the waste of power consequent upon serving water at different levels.

If, sir, you should think this letter worthy of insertion, I shall return to the subject in a short time, and lay before your readers a concise summary of the facts which are at present known respecting the water beneath the London basin. I remain, &c.

W. J.

May 16, 1835.

COOKING BY GAS.

Sir,—If any of your long list of readers are smitten with the desire of diffusing useful knowledge, and are in possession of the information I seek, they will thank me for affording them an opportunity of indulging that laudable and fashionable propensity. A gas-work has been lately erected in this town, and we are trying to make the heat given out in its combustion available for culinary purposes, or, in humbler phrase, to make it boil pots and kettles. We have tried the effect of an apparatus recommended in the fifteenth volume of your Magazine, page 344, and find it answer tolerably well. It consists of nothing more than a cylinder of thin sheet iron, twelve inches high, six inches wide at the bottom, and three at the top; the bottom is open, and the top is covered with a piece of fine wire gauze (forty-six threads in the inch), bound tightly over it by a brass ring. The gas pipe being carried two inches up the cylinder, the gas gets mixed with common air in it, and they ascend together through the gauze, and are set fire to at the top. The result of many experiments made with this machine, and with a larger one of a similar nature (but five inches in diameter at the top), seems to be, that two quarts of water, in a common copper tea-kettle, will be boiled, by the application of three feet of gas, whether burnt at the rate of ten or of twenty feet in the hour. Now, as our price is 12s. 6d. a thousand feet, the expense is only a halfpenny, and therefore we may be said to be already in possession of the valuable secret of making the pot boil. But, if any of your readers, as I said before, can put us up to a better plan, we shall be much obliged to them.

I am, &c.

M. P.

Hitchin, May 7, 1835.

P.S.—I may add, that our gas is of remarkable purity and brilliance, and pleases all eyes without offending any nose. The works were built by Mr. West, of Durham, under the superintendence of Mr. Lowe.

Sir,—Having seen, from several articles in your Journal, that an effectual method of preventing the descent of carriages on an inclined plane, in the event of the chain breaking, is a desideratum, I am induced to forward to you a plan for the purpose, which appears to me likely to meet the end in view.

The plan is as follows:—

Let a double line of rails be laid down, about 18 inches asunder, and secured firmly in the ground in the middle of the path of the carriage, with holes through them at intervals of a yard; and through these holes let iron bars be put, connecting these new or supplementary lines of rails, so that the rails and bars together may present the appearance of a long iron ladder lying on the ground between the rails on which the carriage runs. Upon these rails a small pair of wheels, about 2 feet in diameter, or less, are to run, connected with the upper end of the carriage by means of two bars, 6 or 7 feet long, which are to hook on and off the carriage. Over the axle of these wheels the draft-chain is to go, to raise it from the ground. The motion of the carriage will, by means of the connecting-bars, always carry these wheels along with it. Another pair of iron bars, reaching within a few inches of these wheels, are then to be hooked or fastened to the same end of the carriage (but below the other bars), in any simple way that will insure the free descent of their outer ends when unsupported. The outer ends of these bars are to be connected to each other by a strong spring across them, sufficient to bear the sudden check in stopping the descent of the carriage; the draft-chain must go over and be hooked to this spring; and to the under side of the spring is to be fastened a strong hook, which the draft of the chain will keep off the ground, and allow it to pass freely up and down the inclined plane, without touching the cross-bars. If more elasticity is found necessary, than what the cross-spring of the drag-hook will give, the side bars of it connecting it with the carriage may be made with spiral springs, upon the principle of Salter's spring-balance; and the lower these bars are fastened on the carriage, the less quantity of upward pull there will be on the cross-bars and rails to disturb them in their bed.

Fig. 1.

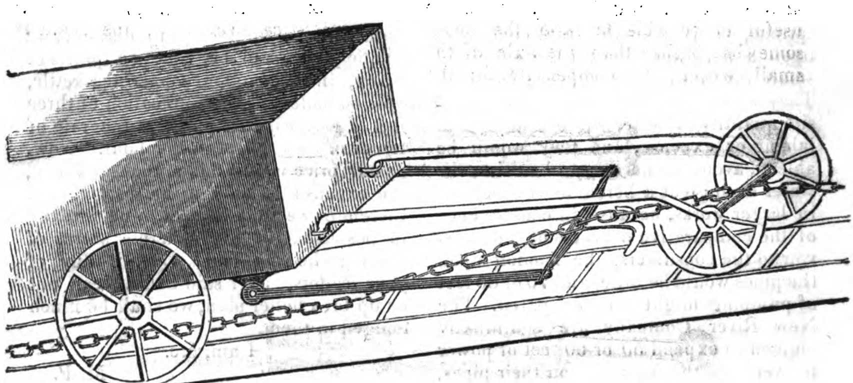


Fig. 1 is a representation of a carriage, provided with such an appendage as I have described, in the act of ascending or descending an inclined plane. The draft-chain is on the stretch, and the drag-hook supported off the ground by the strain of the chain.

Fig. 2.

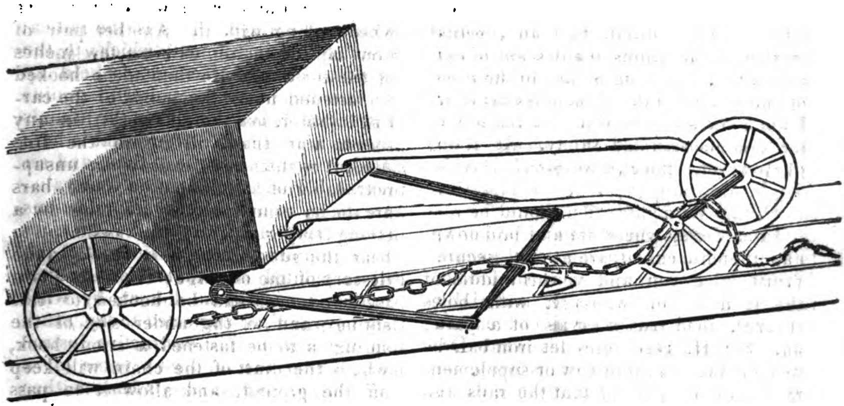
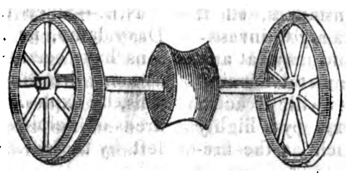


Fig. 2 shows the carriage with the draft-chain broken, and the hook anchored on one of the cross-bars, having fallen for want of support from the strain of the chain.

Fig. 3.



As the draft-chain will not be stretched so tight in transporting carriages down the inclined plane, or drawing empty carriages, as it will in drawing them up, it may be useful to be able to raise the chain somewhat higher than the axle of the small wheels, to compensate for the greater bend of the chain upon those occasions; this can be effected by having a moveable sheave to fix on the middle of the axle, with a deep groove on its circumference, over which the chain is to work, as shown in fig. 3.

Fig. 4.

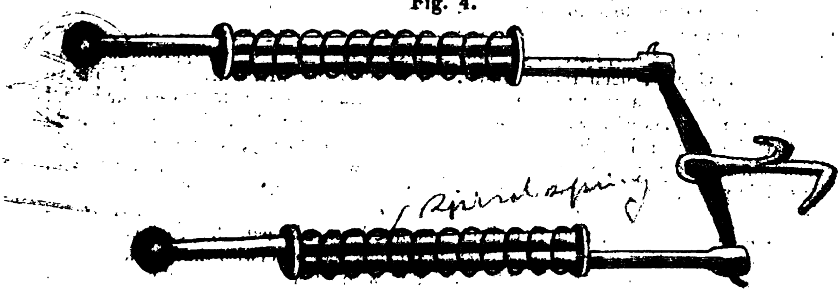


Fig. 4 shows the draft-hook, with the drag-hook under it, the cross-spring and spiral-springs to the side-bars.

It is scarcely necessary to add, that after the carriages have been drawn up or let down the inclined plane, all the bars may be detached, and the rails left clear.

I am, Sir,
Your obedient servant,
C. PUTLAND.

Dublin, Feb. 14, 1835.

Sir,—The determination you invariably show to attack the errors of the great or little, with an unsparing hand, when they become injurious to any class of the community, encourages me to address you once more on the fallacious character of the Davy lamp—for such, I fearlessly assert, is its assumed safety. As I do not, however, expect, like Sir H. Davy's friends, the supporters of its practical safety, that vague assertion should be received as facts, where life and property, to an immense extent, are at risk, I shall, I trust, give you and your numerous readers, many of whom it materially concerns, good reason for its condemnation. Sir H. Davy grounds what Dr. Ure calls the infallibility of his lamp, on the metallic cylinder or wire gauge cage, which surrounds the wick, being composed of small tubes or meshes, which, he asserts, or at least leaves to be inferred, will in all cases prevent the passage of flame. How far small tubes or meshes will, under some circumstances, effect this object, it is not necessary to investigate, when it has been, and may, at any time, be proved, that the metal forming the exterior of these tubes will, if acted on only for a few moments by a highly inflammable mixture, such as the fire-damp of coal-mines, do become a burning mass, and thus itself conduct flame from the interior of the lamp to its outward surface. This is the radical defect of this instrument, which, to the discredit of a scientific age, is held up as a monument of the powerful genius of its inventor, and remains in the miner's hand as a protector. After what is here stated, it would be waste of time, and an inexcusable encroachment on your valuable space, to notice other imperfections in the Davy lamp. It is, however, to be hoped and expected, as the root of the evil is pointed out, that scientific and practical men will no longer, by what they have said, or neglected to say, sanction the use of this destructive instrument, under the fallacious name of a safety lamp. Sir H. Davy's fame neither wants, nor ought to be supported, at the expense of human life and human suffering. Your constant reader,

U. G. R.

N.B.—Since the introduction of the Davy lamp, nearly two thousand persons have been destroyed, and probably as many dreadfully injured in their persons, by explosions in coal-mines. Hundreds of helpless families are frequently left by these fatal events in want and misery.

MR. GURNEY AGAIN.

We observe that the Select Committee, to which the investigation of Mr. Gurney's claims to a national reward for his abortive efforts to introduce steam-travelling on common roads, was in the last Parliament referred, has, on the motion of Mr. Cayley, been re-appointed. Mr. Hawes dropped a reproving remark about the readiness with which the assent of the Crown had been given to this application for another grant out of the public purse, such assent being previously necessary; but the Chancellor of the Exchequer observed, that it did not necessarily follow that a grant of *money* would be the result of a favourable report on Mr. Gurney's application—*the petitioner might be rewarded in some other way.* The "*other way,*" to which the Chancellor of the Exchequer alluded is, of course, an extension of the term of Mr. Gurney's patent. Now, if such be really the understanding on which the assent of Government has been given to the re-appointment of the Committee, its labours need not be of very long duration. It may report at once, without the slightest fear of disapprobation from any body that Mr. Gurney *ought* to have the term of his patent extended—till doomsday if he likes. There is not, we will venture to say, a single individual in the whole mechanical world, who will grudge Mr. Gurney the exclusive use, for ever and a day, of all that is included in his patent. Nor could Mr. Gurney feel otherwise than greatly satisfied with such a result of his appeal to the national generosity—that is to say, *consistently* with his own representations on the subject. Mr. Gurney affirmed, in the course of his evidence before the Select Committee of the last Parliament (see our abridgment of the Mi-

notes of Evidence, vol. xxii. p. 306-23), that when his steam-carriage was driven off the road by the excessive tolls (of which tolls, however, more presently), the invention was "perfect." If this, then, be true, what greater reward could he desire than to have the exclusive use of this "perfect" invention secured to himself and his representatives for all time to come? It would be as good a thing ultimately, to the race of the Goldsworthy Gurneys, as the philosopher's stone itself. For, as nobody has yet been able to boast (truly) of having attained to such perfection in common-road steam-carriage making, by at least a hundred degrees, Mr. Gurney has only to take the field again with his "perfect" invention (all about the tolls being satisfactorily arranged—no difficult matter), in order to carry every thing before him, to the utter annihilation, not only of the whole of the existing tribe of coach proprietors, but to the irretrievable discomfiture and confusion of all other steam-carriage speculators whomsoever.

We are sorely afraid, however, that in spite of the Chancellor of the Exchequer's prudent reservation, and in spite of Mr. Gurney's strong representations of the "perfect" character of his invention, a grant of public money is, after all, the only thing sought for by this re-appointment of the Committee. We apprehend that Mr. Gurney knows too well the real worth of his "perfect" invention, to care one straw for an extension of his patent right to it. We trust, therefore, that the Committee will take a little more pains than they did on the last occasion to come at the actual facts of the case; that they will not accept of worse evidence, on any material point, than the very best within reach—with hearsay testimony, for example, when direct testimony is to be had, and ought to be produced; and that when they have done their best to elicit the truth, they will not rest satisfied with the opinions of such scientific gentlemen only as Mr. Gurney may choose to put forward, to repeat what they have been retained by him (we do not say *hired*) to repeat; but that they will make it their business to ascertain what other equally competent, but more independent (because unfeed), judges, think of Mr. Gurney's steam-carriage performances and pretensions. We would particularly recommend to the attention of the Committee the remarks made by an acute correspondent of this Journal (H., No. 603), on the propriety of having Sir Charles Dance before them, to clear up the doubts which hang over the Gloucester and Cheltenham affair; and also the flat contradictions given by Colonel Macerone in his last steam pamphlet (*Expositions and Illustrations*), to nearly the whole of the statements in Mr. Gurney's petition and evidence. We shall here subjoin those passages of Colonel Macerone's pamphlet which it seems most incumbent on Mr. Gurney to disprove. Colonel Macerone, it is important to observe, not only expresses his own readiness to verify on oath his history of Mr. Gurney's proceedings, so far as it rests on his own personal knowledge, but refers to a number of persons of respectability and credit, by whom his allegations can be confirmed, or, if erroneous, contradicted.

Colonel Macerone's Statement.

In the summer of 1825, I was introduced to Mr. Goldsworthy Gurney, by Sir Anthony Carlisle, with a view to the former gentleman affording me the use of a workshop in his extensive premises in Albany-street, to enable me to make certain experiments in an important mechanical invention. Thus, also, I became acquainted with Mr. John Squire, who was introduced to me by Mr. Gurney, in the capacity of carpenter, to assist me in my operations; and a very intelligent young man I found him; remarkably diligent, discreet, and scrupulously honest. For several months I mainly occupied myself with my own particular pursuit, but could not help observing the progress of Mr. Gurney with his steam-carriages. At that time, and for many months after, he confined his experiments to the running round his own yard; and at length, occasionally round the yard of the Cavalry Barracks, close by.

In May, 1826, Mr. Gurney one day informed me that the carriage which I saw return home with a broken wheel, and the frame sprung, had been up Highgate-hill, at three or four o'clock that morning. I confess that that intelligence very much surprised me, because, having assisted at all the latter experiments, in which the carriage had never been able to run 200 yards, either on the beautiful level road of the Regent's Park, or in the Cavalry Barracks, without stopping, I did not think it capable of any such exploit. Moreover, I well remember, that it appeared to me very suspicious, that

neither myself or any other witness, save his own five or six men, should have been apprised of the intended attempt; and, further, that such should have been executed at such an unseasonable hour!—However, I did not at that time think Mr. Gurney capable of any deliberate plan of delusion, and I began to feel a great interest in the success of the steam-carriage, and to aid Mr. Gurney to the utmost of my power. I will not stop to say what I did towards the improvement of his mechanical arrangements; Mr. Boulnois and others, who were examined on the Committee of last Session, will doubtless remember something about them.—The carriage began to perform better in the Barrack-yard and Regent's Park, and Mr. Gurney had not much difficulty in making me really of opinion that, with machinery improved in its construction, adaptation, and arrangement, the carriage would very soon be brought to do all that would be required.

One day, I think it was in August, 1826, it was a Saturday, walking with Mr. Gurney in the Regent's Park, he told me that after all his application and labour, and after having so nearly brought the invention to a successful issue, he was on the very eve of being utterly ruined and overthrown, for want of a little more pecuniary assistance. That very day, he said, he had been obliged to borrow a sovereign of a friend (whom I need not name), in order to make up his men's weekly wages.*

Feeling a lively interest in his case, and really believing that with a little more money to build another complete carriage or two, it would turn out a very profitable speculation, I asked him, whether in case I should procure him a couple of thousand pounds in a few days, it would be sufficient to relieve him, and ensure his success? In an ecstacy of delight he exclaimed that if I did such a thing, I should ensure his fortune and my own also! In an evil hour, but in perfect sincerity, I wrote to my old friend, Captain Dobbyn, then living at Bath, who immediately came to London. I explained to him the nature and the certain results of the speculation, if it should prove successful. I introduced him to Mr. Gurney, cautioning him to examine, think, and see his way clearly, before he acted upon my suggestion.

On the following Wednesday, being the fourth day after the above conversation with Mr. Gurney, Captain Dobbyn gave Mr. Gurney a check for 3,000*l.* for the Bath road. With regard to the stipulations, writings, &c., between Mr. Gurney and Captain Dobbyn, I did not, from motives of delicacy, at all interfere. The Captain employed his own solicitor,* and from that moment he identified himself with Mr. Gurney's operations.

At my suggestion, Captain Dobbyn spoke upon the grand subject to Mr. Hanning, of Dillington Park, Somerset, and we jointly introduced him to Mr. Gurney. This gentleman, in the space of a few months, advanced Mr. Gurney upwards of 15,000*l.*; and I, on one occasion, heard him say, that if *money only* was wanting to bring the carriage into practical use, an expenditure of *forty thousand pounds* should not stop him.† I next introduced him to Mr. Waterhouse, of the Swan with Two Necks, Lad-lane, who at that time had no less than twenty-three or four of the mails, besides a multitude of other coaches. This gentleman was very anxious, and even impatient, to pay down several sums, on account of licenses, to run steam-carriages on a number of roads, beginning with three upon each; but Mr. Gurney, flushed with the tinkling of Captain Dobbyn's money, in his pocket, excited by his high tone of confidence, and ill-judged defiance to horse-coach masters, very luckily for Waterhouse, and, as it turned out, morally so for me, got on his high horse, and actually refused to allow Mr. Waterhouse to see the performance of the carriage which he had shown Dobbyn, &c., declaring that as he was then building two or three which would be *perfect*, Mr. Waterhouse should wait for their completion. Mr. Waterhouse assured me that to induce him to make a first payment, it would be sufficient for him to see 'the Highgate-hill' imperfect shattered carriage; because, if it only performed six or seven miles the hour, he would know how to make allowance for its limited qualities, which of course would be immeasurably excelled by the 'perfect ones,' then in hand. Such, however, had become the petulance and arrogance of Mr. Gurney, that one day he was only prevented by me from actually ordering his men to turn Mr. Waterhouse out of the factory-yard!

In the interim, I introduced Mr. W. Boulnois, Mr. Abbott, Mr. Davies, and several other 'men of money,' and great intelligence in speculative affairs. Mr. Boulnois paid Mr. Gurney 600*l.* I believe it was for the monopoly of the Brighton and Worthing roads; and I was told, another 500*l.* for the Southampton-road.

* I did not then know that he had already received 500*l.* from Mr. Ward; 2,000*l.* from Dr. Mackey; 5,000*l.* from Colonel Viney; and several thousands (I am told five) from Mr. Thiselton, of the house of Sir James Cockburn and Co.

* Mr. Butterfield, of Gray's-inn-square. (*This gentleman would make a good witness on the revival of the 'National Reward' Committee.*

† He repeated this in the presence of Mr. Portell, of 15, Clifford's Inn, whom he for some time employed as his attorney.

I must confess that at this time I was a sincere participator in the delusion as to the *future* capabilities of Mr. Gurney's boiler and machinery. It was impossible not to see that *as yet* it was wholly inadequate to the end proposed—but the gentleman who, through my introduction, advanced their money, had equal opportunities with myself of judging of what they saw.* Nevertheless, I must own that, as it was, I did contribute considerably to the confidence which placed in Mr. Gurney's hands an amount of funds, one-tenth of which would have been more than adequate to bring forth the merits and capabilities of his plans, beyond all possibility of mistake, had there been any merit and capability in them.†

* * * * *

The great *cheval de battaille* of Mr. Gurney and his backers, in the matter of parliamentary compensation, was a parliamentary wrong inflicted on him in the way of 'prohibitory tolls;' and it was contended and sworn to, by a number of witnesses, that the tolls alone were the cause of his failure. Now, notwithstanding the palpable absurdity and falsehood of that pretence, it may be well for me to show the clear, public, and well understood real cause of the failure at Glasgow, which, to my utter surprise, Mr. Ward was prevailed upon to disguise, in order to chime in with the piece performed before the Committee. Mr. Ward had repeatedly told me quite a different story—that is, the true one; and I know several other persons who can confirm the facts. Here is an extract from a letter of Mr. Angus Macleod, of Glasgow, who was Mr. Gurney's and Mr. Ward's agent in the affair of the sale of the patent for Scotland, written nearly a year before the publication—of the 'Minutes of Evidence.'

Extracts of a Letter from Angus Macleod, Esq., to Colonel Macerone.

"Glasgow, October 11, 1833.

"At the period I first embarked into the speculations of steam-carriages, 45,000*l.* would have been paid for Gurney's steam-carriage patent for Scotland, had the experimental carriage, with which Mr. Gurney came down, performed *one* effective journey from Edinburgh to Glasgow! But, I am sorry to say, that it took three days to cover the distance, and I was hooted and laughed at, to be the progenitor of introducing such an invention to Scotland, &c. The parties, composed of the cream of this country, in money matters, and I have the first class of land-owners in the vicinity of Glasgow, who are all my friends, still hold together, and are as anxious as ever to adopt the *first* effective carriage on the field *here*. But as yet, *those who pretended to do, could not do* AT ALL. Messrs. Girdwood, Nelson, Bain, Messrs. Scott, Sinclair, and Co., Mr. Ferrie, and all, say, let us *see* something tangible."

I have several others to the same effect, but, for the sake of brevity, I will only add an extract from one which I received this day from the same gentleman:—

"Glasgow, Feb. 25, 1835.

"I am exceedingly surprised at Mr. Ward's conduct, (however unfortunate he has been through Mr. Gurney's representations), that he should have recourse to such stratagems, when he must know, that, when such are known, it must lead to disgrace him. I know him and Gurney perfectly, and I must regret the day I became acquainted with either of them. The first Thursday in March, 1831 (I believe it was the day), Gurney, with a party, and I one of the number, started from Edinburgh to Glasgow. When about two miles on with the carriage it stopped. The caps had to be taken off the cylinders, the pistons taken out, and new springs put in. On Saturday morning following, Mr. Gurney, Dr. Anderson, of Edinburgh, and I, started again, and travelled eighteen miles (about nine miles the hour); then suddenly stopped within two miles of the half-way-house; got horses to it, and after undergoing some repairs of leakage, started, *and, with some assistance on the road*, got the carriage to within two miles of Glasgow that evening. *Other experiments performed were equally unsuccessful.* Proper management was wanted, AS WELL AS A TIGHT BOILER and proper machinery."

With respect to the pretended tolls, Mr. Macleod adds,

"The Trustees on the Paisley line of road, through Mr. Wallace's (M.P.) influence, *gave twelve miles free of the road from tolls. Sir Alexander Maitland Gibson, of Edinburgh, agreed to do the same, and the question of tolls was a trivial matter.* The purchase of the patent entirely depended upon the success of the carriage on its trips from Edinburgh to Glasgow, &c.

(Signed) "A. MACLEOD."

"To Colonel Macerone."

Now, what do you think of this, Messieurs of the Committee, engineers, savans, wards, creditors, and sop expectants! Mr. Wallace knows Mr. Macleod. Ask Mr. Wallace, who is of your Committee, if he disbelieves him. If he does, I will bring scores of other persons who *saw* the miserable failure of the thing, which I am accused of having copied. The boasted ascent of Highgate-hill, too—there is another pretty piece of 'humbug;' *after* which achievement Mr. Hancock, and so many others, were smitten with emulation to build steam-carriages 'in imitation of Mr. Gurney!' The only carriage Mr. Gurney had then, was a frame, with the boiler, &c., upon which was placed a cabriolet body. I had often seen it crawling round the yard of his factory, and at-

* I worked in my shirt-sleeves and apron, from morning to night; and whenever any person came to the factory, to talk, or to treat, Mr. Gurney would say, 'Speak to the Colonel—whatever he agrees to, I will confirm.'

† After Mr. Gurney's plans had been put to every possible test that unlimited funds could furnish, and had been *proved* to be utterly worthless, Captain Dobbyn became loud in his reproaches towards me, for having introduced him to such a ——— (I dare not mention his expression). I silenced him, by reminding him, that he had over and over again asserted that Mr. Hanning had, in the beginning, repeatedly offered him (Dobbyn) 6,000*l.* for his 3,000*l.* bargain with Mr. Gurney. Now, this assertion I can prove by several witnesses! So, if Captain Dobbyn chose to refuse such an offer, why reproach me?

tempting to run a few hundred yards in the Regent's Park, or, more frequently, in the favourite place—the yard of the cavalry barracks, close by. Never could it move faster than five miles the hour, at the utmost; and, as Mr. Hancock observes in his letter above given, never had it gone a hundred yards without stopping, from some cause or other. Judge, then, of my surprise at being one day informed by Mr. Gurney that this carriage had been up the old Highgate-hill that same morning, at four A. M. I was simple enough to believe him; but, to to be brief, the fact is, that the *empty* carriage, or rather frame, was helped up the hill by four or six stout men, who, after stopping a score of times, and a good hour's pushing, puffing, sweating steaming, managed to get it up to the top!. In coming down again, however, the carriage was upset; but what of that! having been *up* that terrible hill, it came home in triumph, drawn by horses. The so much talked-of 'journey to Bath,' in which my friend Captain Dobbyn was one of the party, was executed somewhat better, but, any how, not as it is so ignorantly exulted upon. The carriage was taken secretly, *by horses,* to Cranford-bridge on one day; the next the fire was lighted, and it went by steam, in one entire summer's day (if not in two, as I am told), as far as Melksham. Here, again, recourse was had to horses, which drew it on to Bath! The same order was observed on its return—horses to some miles on this side of Melksham—steam to Cranford-bridge—then horses home!* Now, I beg to inform those whom it may concern, that, independent of other testimony, I have had, for two years, the very same men in my employ who were at the Highgate hill business, at the Bath journey, and at the Cheltenham *speculation.* I have, it is true, questioned them very little on any of those matters, because I observed a very marked, and, we may say, proper reserve and reluctance to say any thing about them; but I shall now make a point of getting at all the particulars. I myself saw the much talked-of ascent of Stanmore-hill, and I can safely declare that it was effected by a similar process to that of Highgate.

* * * * *

I will not *now* observe upon the long rigmarole about the difference between horse muscular power and steam-power, with which Mr. Gurney has completely flabbergasted and edified the honourable gentlemen, as the village parson edified his flock, by composing his sermon almost exclusively of Latin quotations. What a sermon! cried the villagers. What a man of miraculous powers of invention! exclaimed the honourable members. But I will leave all this 'miraculous' stuff, and just give you a few of the words which were said on one particular point of the subject, that is, the much talked of 'SEPARATORS.'

[Here follows extracts on this point from the evidence of Mr. Gurney, Mr. Gordon, Professor Faraday, Dr. Lardner, and Mr. M'Neill.]

Now, good reader of mine, what do you think about all this and these wonderful '*separators?*' * * * Yet, would you believe it, neither the Cheltenham nor the Edinburgh carriages had any 'separators' at all!!! Mr. GURNEY HIMSELF *had thrown up his indispensable separators, and constructed several boilers entirely without them!* He substituted in their stead a huge flat '*front,*' as it was called, placed just at the backs of the passengers, consisting of a flat rectangular chamber of parallel surfaces, similar in shape to *one* of the sections or chambers of Mr. Hancock's boiler, only containing ten times as much water, fifty gallons. Safe, if so dangerous a formation can ever be called safe!—safe, I say, merely by thickness of metal, and by a great number of strong bolts with which the two surfaces were held together! At the sale at Mr. Gurney's factory, in July 1832, there were several of these 'backs' or fronts laying about; and two new steam-carriages, which were then and there sold, had such 'backs,' and no parliamentary 'separators,' or 'horizontal chambers,' belonging to them! So uncertain and bewildered was the 'miraculous' man at the miserable working of his boilers, that he actually built more than one with steam receivers, or separators, placed horizontally UNDER THE BOILER, IN THE ASH-PIT!!!

I assisted at the construction of several of the first carriages, and Mr. Squire had a hand in all that Mr. Gurney built; the Cheltenham and Glasgow carriages included. The best and most confidential working engineer in the employ of Mr. Gurney was Mr. James Wearn, whose letter, addressed to me from Paris, has been seen at page 58.* He had the principal hand in the construction of the carriages and boilers we are speaking about; and, together with his brother, and four others of Mr. Gurney's late smiths, boiler-makers, &c., have been a long time in my employ; and if the Committee, or any one else, would like to question them, they, as well as many others who have not been called, can give them a little real *matter of fact* information!

* Mr. Gurney always endeavoured to go out as privately as possible, with no other witnesses than his own men! He could then boast of his performances with impunity!

* Inserted in the Mech. Mag., No. 603.

NOTES AND NOTICES.

Naturalisation of the Mango in England.—The mango, so celebrated in the East for its delicious fruit, has been ripened in England by Earl Powis; and, in the opinion of naturalists familiar with Indian botany, might be more extensively cultivated here, than, from its usual arboreous nature, might be supposed possible. Mr. Royle states (Illust. Himalayan Mountains, Part VI.), that "by grafting and transplanting the ordinary growth is much impeded, and shrubs of less than four feet in height have borne, in the Saharunpore Botanic Garden (N. India), above a dozen mangoes. It would be necessary only to imitate the climate, by giving a green-house cold in winter, rapidly raising the heat in February and March, and continuing it till May and June, or about the time of the accession of the rains, when the addition of moisture to the heat is indicated; as the mangoes only perfectly ripen after the atmosphere has become moist in the rains."

Densities of Bodies at different Depths.—Professor Leslie observes, that air, compressed into the fiftieth part of its volume, has its elasticity fifty times augmented; if it continue to contract at that rate, it would, from its own incumbent weight, acquire the density of water at the depth of thirty-four miles. But water itself would have its density doubled at the depth of ninety-three miles, and would attain the density of quicksilver at the depth of 363 miles. In descending, therefore, towards the centre, through nearly 4000 miles, the condensation of ordinary substances would surpass the utmost powers of conception. Dr. Young says that steel would be compressed into one-fourth, and stone into one eighth, of its bulk at the earth's centre. However, we are yet ignorant of the laws of compression of solid bodies, beyond a certain limit; though, from the experiments of Mr. Perkins, they appear to be capable of a greater degree of compression than has generally been imagined.—*Mrs. Somerville.*

The Post in India.—The Post-office is in almost all countries a monopoly. India is an exception to this rule. The present mode of conveying the mail is by runners, who travel at the rate of about four miles an hour. In some parts of the Deccan, a horse post has been tried, and in one instance a light carriage. The nature of the country is at present unfavourable for the use of these improvements; but as it advances in prosperity, the importance of rapid and certain modes of communication will become apparent, and the means will, doubtless, be provided. The post is yet little used by the natives, and the revenue derived from it is trifling.—*Thornton's India.*

Mr. Collier's New Boiler, which has been for some time on trial on board His Majesty's steamer Meteor, has turned out so ill that the Lords of the Admiralty have ordered it to be removed and the vessel to be placed out of commission, till she can be refitted with boilers on the common plan.

Howard's Vapour-Engine.—The Nautilus has arrived at Falmouth with letters from Lisbon of the 11th. The Comet, which had left Lisbon on the 8th, was obliged to put back with her machinery out of order. The plates immediately in contact with the heated quicksilver had burst, and rendered her unmanageable. The new invention has, therefore, so far failed; but it is to have another trial.—*Times.*

English Silver Ore.—There was sold last week, at the Bank of England, the largest mass of English silver ever received into that establishment. Its weight was 5741 oz., and its value upwards of 1,500*l*. It was the produce of a mine in the eastern part of Cornwall, at which ores containing from 500 to 1000 oz. per ton of ore are not unfrequently raised.

Mr. Pinkus is applying for another patent for what he calls "an *improved* method of, or combination of method and apparatus for communicating, transmitting, and extending motive power, by means whereof carriages or waggons may be propelled on railways or roads, and vessels may be propelled on canals." Has he found out then, at length, that the plan, as it stands, won't do?

Indian-Rubber Boat.—The *Providence Journal* gives a description of the Indian-rubber boat—a neat affair, weighing about 20 lbs., which may be folded up and carried about from place to place. It will sustain a ton weight, and accommodate quite a fishing party!

Parliamentary Tunnelling.—We are glad to observe that the Thames Tunnel job has been brought under the notice of the House of Commons by Mr. Walter. It now appears that the loan of 247,000*l*. was authorised by an Act of Parliament smuggled through the Lords and Commons last year, with such underhand adroitness, that nobody, except those in the secret, ever heard of it before; much in the same way, we presume, that the Glasgow Lottery Act was smuggled through; and for like honourable and patriotic ends. We have hitherto doubted Mr. Brunel's talents in the tunnelling line, but after this, we must be silent; for though he has not yet been able to undermine Old Father Thames, he has achieved what is almost as great a work—he has undermined (i. e. undertunnelled) both Houses of the British Parliament—driven a shaft all the way from the Thames, at St. Stephens, to the Treasury Chambers, Whitehall.

The Freyburg Suspension-Bridge.—We regret to learn, from a friend who has just returned from Switzerland, that, in consequence of some symptoms of insecurity exhibited by the suspension-bridge at Freyburg, described in our 611th No., the local authorities have ordered it to be stopped up for the present.

New Suspension-Bridge.—According to the French papers, an engineer at Rouen has lately obtained a patent for a suspension-bridge, which will have at the central point an arch of sufficient elevation to admit the highest mast to pass under it. The drawbridge is said to be of so simple construction, that it may be raised by one person with the greatest ease. The arch will be sufficiently strong to support the chains, which are to extend from it to each side of the river.—*Athenæum.* This reads very like nonsense. The arch at "the central point" is to support the main chains (instead of towers and counterforts on each side as usual); but what, pray, is to support the arch? This discovery of a method of making suspension-bridges support themselves, comes with admirable propriety from a country, the engineers of which have acquired an unfortunate celebrity for so putting up bridges of this description that, with all the supports they can bring to them, they never stand! For one suspension-bridge of English construction which has given way, there have been at least six times as many of French. In England, failure is but the exception; in France, it has hitherto been the rule.

The Apple in India.—Mr. Royle states, in the last No. of his splendid "Illustrations of the Himalayan Mountains," that the apple has been found to succeed extremely well in the southern parts of India, especially about Bangalore and Tirhert; and that it yields also in northern India fruit which, though small, is of a good quality. The propagation of the tree in the east is, however, much impeded by the difficulty attendant on the introduction of European varieties. "An apple-tree from Liverpool, in consequence of being the only one which survived, cost upwards of 70*l*. before it was planted in the nursery at Mussooree."

Curious Catalogue of Books.—Mr. Briggs, the "scientific bookseller" of Parliament-street, has just announced the completion of his "catalogue of new and second-hand books for 1835, in all languages, and on all subjects;" some of which he "flatters himself will be highly interesting to the members of the civil engineers, and the amateurs of practical science in general." Judging from the printed specimen which Mr. Briggs (or somebody else) has sent us of the catalogue, it must be a very curious affair. Among the *perfect uniques* there are two particularly deserving of notice. One is, "Records of the Smeaton Club, edited by Sir John Rennie, 21 thick quarto volumes" (! ! !); the other, "Transactions of the Institution of Civil Engineers, all the volumes up to a certain date (query 1835 ?) wanting." ! ! ! !! !

The London and Birmingham Steam Company (Dr. Church's concern) are advertising their "*opinion*" that "all the difficulties of running steam-carriages upon gravel roads are now overcome, and that it will be done to great profit to those engaged in it, and immense a vantage to the community at large;" not only so, but they have actually had the bravery to resolve, "that the directors be *requested* (why not *authorised?*) to build, as soon as possible, the necessary complement of engines, for establishing regular lines of coaches from Birmingham to London." If the thing be, in the "opinion" of the Company, so perfectly clear and certain, why so much advertising and puffing about it? Why not put the carriages on the road at once?

The London Mechanics' Institution anniversary was celebrated on Wednesday last, when, for the first time these ten years, Dr. Birkbeck was NOT apostrophised as the *Founder* of the Institution. Truth, then, has at last been *so far triumphant*. We half-expected that Lord Brougham would have honoured this triumph of Truth with his presence; but his lordship seems to have been otherwise engaged. Possibly his lordship may have thought that Truth could shift for herself very well without him. In the *Times* report of the proceedings of this anniversary there is a typographical error, which, considering the obstinate partiality of that journal for his obstinate lordship, looks almost as if it had been intentional. A vote of thanks is there stated to have been passed to Dr. Birkbeck as the "enlightened *institutor* of the institution." The word actually used was "*instructer*;" and so it is given in all the other daily journals which we have seen.

The Railway Buffing Apparatus lately invented and patented by M. Bergin, and now in full operation on the Dublin and Kingstown line, has given already some remarkable proofs of its efficiency. About a fortnight ago, a train of ten carriages came with such force against one of the stationary buffers, placed at the ends of the line to make the trains bring up easily, as to tear it completely from its foundation, and crush the framework of the buffer-rod of the first carriage—that which more immediately sustained the shock; yet so slight was the effect on the carriages in the rear (the shock being absorbed, as it were, by the series of buffers connecting them), that the passengers were not in the least inconvenienced. Again, on Monday last, a steamer, with seven carriages in its train, came in collision with a coke waggon at one of the crossings, and was, with its tender, thrown quite off the rails, with not a little damage to both; but so little were the passengers aware of what had happened, that they put out their heads inquiring the cause of the stoppage! Had such accidents as either of these happened on any other railway, or on this without the buffers, one-half of the passengers would have been pitched out of the carriages, and, in all probability, many of them severely injured.—VIATOR. —*Dublin, May 16, 1835.*

The London and Birmingham Railway is chiefly in the hands of large capitalists. There is one holder of a thousand shares, another of five hundred. A call of 10*l.* per share (making 35*l.*) became payable on Wednesday, the 15th of April, and we hear that more than 200,000*l.* was received by the treasurers before the end of the same week.—*Birmingham Advertiser.*

Portable Steam-Engines, such as A. B. inquires after, or as they are called in France *locomobiles* (a much fitter name), may be had of any respectable steam-engine-maker. Those alluded to in the paragraph he refers to were made at Manchester.

The Spring-Water Bubble.—A correspondent at Hammersmith has furnished us with the following corroborative instance of the falling off in the supply from the spring-wells in and around London, alluded to in the letter of a "Manufacturer," inserted in our last Number:—"A gentleman in this neighbourhood had a well, in which the spring at first rose twenty feet *above the surface;* but it has in the course of a few years diminished so much, that at the present time it stands at five feet *below* the surface."

Mr. Cundy's "Observations on the Midland Counties' Railway," are not written in a fair spirit, or with sufficient attention to facts. He thinks it barely possible that he has "yet a lesson to learn." He may depend upon it, that he has yet a great many to learn. He asserts in the paper which he has sent us, that on *his* Great Northern Railway (*in nubibus*) coal "may be conveyed on the whole line at an average of a *halfpenny per ton per mile*" ! ! ! Now, every person of railway experience knows, that this is impossible. Even at eight times that sum, the conveyance of coal (by itself) is a losing concern.

We shall give, in our next, the first of a series of papers on Railways, by John Herapath, Esq.

Advertisements for our Monthly cover must be sent in on or before the 27th.

Communications received from Mr. Baddeley—Mohawk—Mr. Birdseye—Mr. Fulton—V. L. A.—Emilius—Mr. Nelson—Aquarius.

The Supplement to our last Volume, containing Titles, Index, &c., with a Portrait on Steel, of Samuel Clegg, Esq., C. E., is now published, Price 6*d.*; also the Volume complete, in boards, Price 8*s.* 6*d.*

Our Publisher will give One Shilling and Sixpence for copies of the Supplement to Vol. IX.

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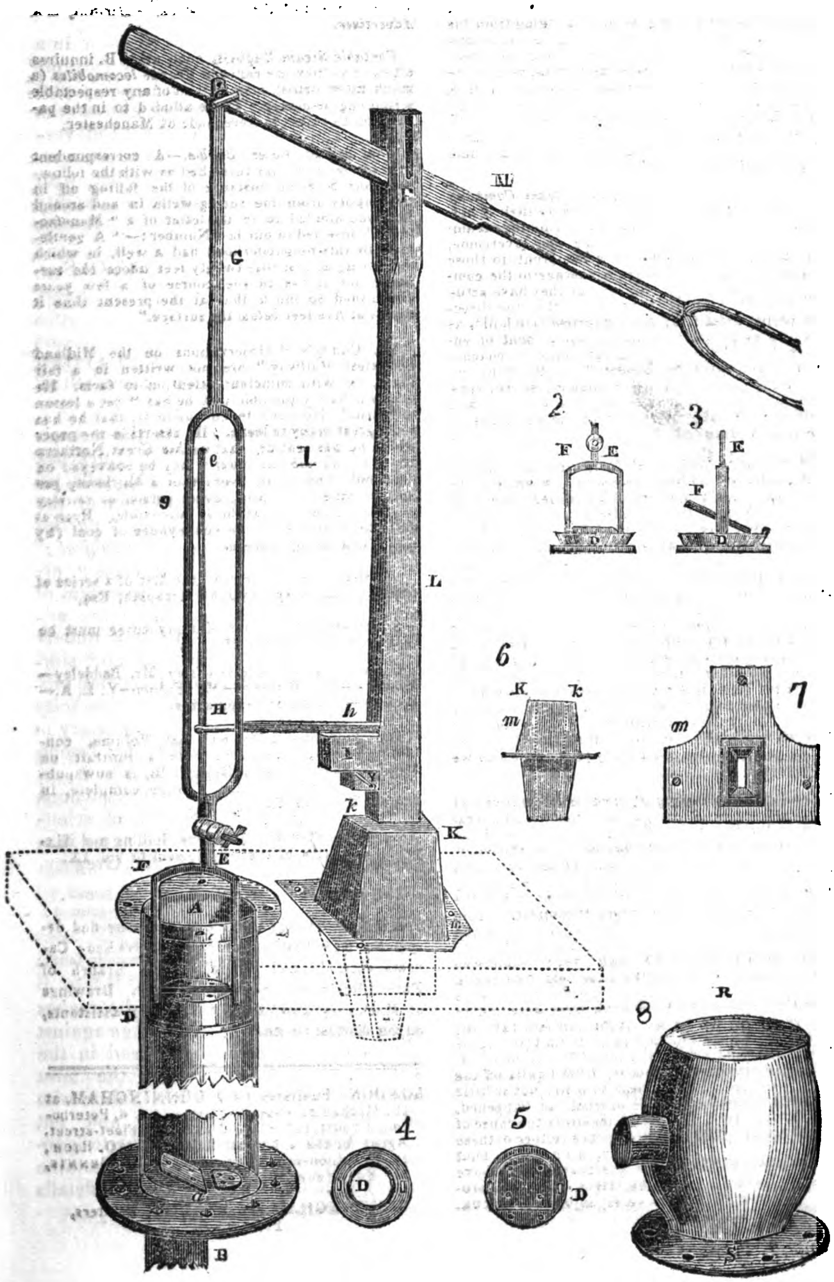
WOOD AND QUANTRILLE'S PATENT PUMP.



WOOD AND QUANTRILLE'S PATENT PUMP.

The writer of the present article is induced to invite attention to the patent pump, which is the subject of it, because he has himself had personal experience of its superiority over other pumps, and believes he will be doing a service, both to the ingenious patentees and to the public, by making its merits more generally known.

The construction of the pump, as will be seen from the prefixed engravings, is remarkable for its simplicity. A perspective, and in part transparent, view of it is given in fig. 1. A is the working chamber; B the suction-pipe; D E F the valve-box, staple, and spear; G *g* the pump-rod; H *h* the stay for pump-rod; I P L the stauncheon; K *k* step to receive the staunchion; M *m* plate for step of the staunchion; N pump-handle. Figs. 2, 3, 4, and 5, are detached views of the valve-box, staple, and spear; fig. 2 exhibiting the valve shut, fig. 3 the same open. Fig. 6 is the step, and fig. 7 the plate for the step of the staunchion. Fig. 8 represents a cistern-head with flanch and nosle.

The point to be particularly noted, in the construction of this pump, is the peculiar position of the suction-pipe B. Instead of being situated under the centre of the barrel, as in other pumps, it is fixed *on one side;* which not only admits of its being much larger in the bore than usual, but leaves that bore completely open and unobstructed. In the suction-pipes of the pumps in common use the bore is always less at the end attached to the barrel than at the lower end, in consequence of the valve occupying a considerable part of the orifice; and to the extent of the difference, is their efficiency necessarily diminished. The advantages of the simple but important change of position made by Messrs. Wood and Quantrille are, *first,* that a greater quantity of water can be raised by their pump in a given time than by any other known to the writer—one of 6 inches bore, worked by one man, being capable of raising upwards of 76 gallons of water per minute; *second,* that it is not liable to be choked, all foreign matters that may happen to be sucked up with the water having an open and free passage from the suction-pipe to the working chamber, and thence to the discharge-pipe.

The portability, or rather locomobility, of this pump, is another circumstance well deserving attention. It may be shifted or unshifted by one person in a minute's time; and removed by a couple of men from one part of a person's premises, and refixed to another in less than a quarter of an hour. On board of vessels of war, where the decks are often required to be cleared of a sudden, with the utmost possible dispatch, this facility of removal would be found of immense advantage.

C. G. S.

Southampton, May 6, 1835.

APOLOGY FOR THE GREGORIAN SYSTEM OF CHRONOLOGY, AND NEWTONIAN THEORY OF THE TIDES.

Mr. James Luckcock, in the memoir of his brother Mr. Joseph Luckcock (Mech. Mag., vol. xxii. p. 609), tells us, that the Gregorian emendation of the Julian Calendar exhibits a "*partial and imperfect knowledge of the subject;*" and, again, that it is "*a clumsy attempt;*" and this is said of a system of chronology, which has been the admiration of every one capable of understanding its extreme beauty and simplicity, and which Sir John Herschell pronounces to be "*of remarkable simplicity and neatness.*" But it was necessary to vilify it, to make room for Mr. Joseph Luckcock's new system, which is to procure for its author "a conspicuous niche in the immortal temple of scientific fame," and to unite his name in a trio with those of Julian (?) and Gregory.

> Three sages, at three different periods famed,
> The erring steps of wand'ring Time reclaimed:
> A Pagan first, the circling seasons classed;
> The next a Pope; a Polisher the last:
> The first, midst Roman bucklers, strode to fame:
> The last, by making buckles, did the same.

Now, sir, our biographer, who makes such a furious *anti-popery* charge against poor Gregory, is so deeply read in the subject, that he has made the most notable discovery that it was *Julian* who first amended the calendar, and not Julius Cæsar, as has been hitherto ignorantly supposed. Let us now examine whether he be as well read in the details of the system as he is in its history.

In pointing out its defects, he says, "*the excess of the six hours is provided for by our leap-year, but no provision whatever is made for the remaining time:*" so that he has discovered that the allowance of six hours is *insufficient*, and that no provision is made for the remaining time, whereas most *other* writers on the subject have supposed that six hours was an *over* correction.

But waiving any consideration of this blunder, we next come to the positive assertion, "that no provision whatever has been made for the remaining time." Supposing that this last expression means the time that is *over allowed* for by the Julian leap-year, if this assertion were correct, in what consisted the Gregorian emendation? Was it merely for the purpose, as Mr. James Luckcock asserts, of lopping off *ten* (not eleven) days from the calendar? No, sir; all the world knows, that by a beautiful and simple scale of compensation, the errors consequent upon the unmanageable nature of the solar year were provided for, and that not only for the time being, but also for a period of 3,000 years in advance; and although it was not considered necessary to carry the enunciation further at that time, yet the rules are capable of further extension to the end of time.

I shall now, sir, offer to your readers an analysis of the Gregorian system; not that I suppose any of them are as ignorant of the subject as Mr. Luckcock, but to save such amongst them as are not very conversant with it the trouble of reference and calculation:—

All Years of the Christian Era which shall be.

1st, Even multiples of 4 shall be leap-years of 366 days, and have the sign *plus*.
2d, Even multiples of 100 shall be common years of 365 days, and have the sign *minus*.
3d, Even multiples of 400 shall be leap-years of 366 days, and have the sign *plus*.

Here ends the Gregorian rules, further correction being unnecessary for nearly 3,000 years; but the rules continued in the same spirit are as follows:—

4th, Even multiples of 3,600 shall be common years of 365 days, and be *minus*.
5th, Even multiples of 50,400 shall be leap-years of 366 days, and be *plus*.
6th, Even multiples of 2,520,000 shall be common years of 365 days, and be *minus*.

Thus we provide correction for two millions and a half years, and may, of course, extend the rules *ad infinitum*, taking care always that the signs be reciprocating or alternate. The necessity for attending to this *last* property of the system, seems to have been overlooked by Sir John Herschell in his Treatise on Astronomy, when he proposes to fix the next stage after 400 at 4,000 years, instead of at 3,600, as above stated. Had it been so fixed, although it might answer for the time being, yet it would have obliged the next following stage to have been of the same sign as itself, both being minus; and would, of consequence, have diminished the common year to one of 364 days, which would have been quite contrary to the spirit of the Gregorian compensation, which beautifully confines all years to either 365 or 366 days.

Let us now apply the foregoing rules to an example:—

To find whether the Year 2,000 be a Leap-Year or not.

2,000 being an even multiple of 4 is by rule 1st constituted a leap-year.
.... 100 is by rule 2d reduced to a common year.
.... 400 is by rule 3d reinstated a leap-year.

And it will consequently be a leap-year.

Next, to prove the critical correctness of the rules, let us find by their aid how

many leap-years have elapsed since the birth of Christ, and, of consequence, the number of days to the end of the present year:—

1835, by rule 1st, hath of leap-years	458, sign	+
.... 2d, there are disqualified	18, ..	—
.... 3d, there are reinstated	4, ..	+
	444	

Then $444 \times 366 = 162504$
And $1391 \times 365 = 507715$
670219

Now the decimal of the solar year, $365^{d.}\ 5^{h.}\ 48^{m.}\ 49.7^{s.}$, being 365.242242, multiplied by 1835, gives 670219, the same result.

Let us next see if the rules be equally exact in their more extended state, and take for that purpose a million of years hence; we shall then have the year 1,001,835:—

1,001,835 multiples of	4	rule 1st	+	250458.7
... ...	100	.. 2d	—	10018.3
... ...	400	.. 3d	+	2504.5
... ...	3600	.. 4th	—	278.3
... ...	50400	.. 5th	+	19.8
				248686

Then $248686 \times 366 = 88823076$
And $759149 \times 365 = 277089385$
365912461 days.

Again the decimal $365.242242 \times 1001835 = 365912461$, being again the same result.

With respect to the other splendid Luckcockonian discovery of the cause of tides, it might be as unceremoniously dealt with as the foregoing, leaving the author in the predicament of having neither time nor tide favourable for his voyages to the aforesaid temple of fame. But, Mr. Editor, I have already occupied too much of your patience and my own time; I shall be content, therefore, with putting one question—what is to become of the ocean near the poles, where the centrifugal motion is almost nothing? There must be rather extraordinary tides in that quarter were the Luckcockonian theory accepted in lieu of Newton's exploded system. He must also send a polite message to the moon, requesting her ladyship not to exercise such potent influence on our tides at her full and change, or else she may one day get pulled to pieces by our 50-horse power attraction.

MOHAWK.

May 12, 1835.

ON RAILWAYS. BY JOHN HERAPATH, ESQ.—NO. I.

Railroads, at length, bidding fair to become the pivot of great national changes, induce me to make a few observations, for the purpose of enabling the public to distinguish between projects substantially good, and useless chimeras.

It is scarcely needful to observe, that Liverpool and Manchester have had the honour of setting mankind an example in the carrying of passengers and goods on railways, with a speed, which, ten years since, it would have been insanity to expect, and of demonstrating, beyond the power of dispute, their advantages to the community, and the large profits to the undertakers of similar projects, when based in reason, and guided by prudence.

For a railway to be successful, the concurrence of two circumstances is ne-

cessary—first, plenty of trade between the termini of the line, and the country through which it passes; secondly, that the country be so chosen that a *good working* line can be easily constructed. Either circumstance being deficient, the other is useless. Now the amount of trade and passengers being in any case easily within reach, I shall limit my observations to the requisites of a good working line. On this point it is that success must ultimately rest, and that deception is most generally practised, not only on the subscribers to railways, but on the Legislature which has to sanction the undertakings.

A good working line must be—first, very nearly level, in no instance rising more than 10 feet, or, at most, 15 feet per mile, unless for a short distance preceded by a descent or a long level; secondly, as nearly straight as possible, and free from all sharp curves, except near the termini; thirdly, if carrying passengers be an object, it must be devoid of tunnels, the bane and pests of railroads. In all cases I assume the rails to be well laid, and the road firm and steady.

Such are the elements of a good railroad, and, after satisfaction on the articles of traffic, are the tests by which every one should be tried previous to supporting it. Besides these, there are others, which, though little or nothing attended to, contribute much to the good working and success of railroads. Hereafter they may come under my notice, but at present my business is with the grand points. With regard to the first element, it flows from that which constitutes the beauty and value of railways, that is, the exceedingly small amount of traction on rolling friction. This is but 1 in 240 of weight. Every ascent, therefore, of 1 in 240, or 22 feet per mile, doubles the force, and consequently the expense of conveyance. Of course 11 feet per mile increases the expense a fourth, or by a fourth diminishes the speed * or weight to be carried. Now, if we consider that the whole weight carried on a railroad cannot exceed the weight carried on the most difficult part of it, if of any length, the value and truth of our first condition is apparent, namely, that no well-constructed railroad should incline, for any considerable length, more than 10 or at most 15 feet per mile; and more especially if the operations of a little wet and heavy dews are to be taken into account. Much sharper inclinations, in which the lengths are small, or the whole perpendicular height to be ascended does not exceed about 20 feet, might, under peculiar circumstances, be profitably employed.

Of the importance of avoiding inclinations, a better example cannot be given than that on the Manchester and Liverpool Railroad. There the Whiston and Sutton inclined planes, which are only about 1½ mile each, ascending 1 in 92, or about 56 feet per mile, and so little that the eye can with difficulty distinguish the inclinations, reduce the speed without extra engines from 33 to 8, or 10 miles per hour in the course of half a mile, or not unfrequently to a stand still; and tax the Company for two helping engines with an additional expense of 1,000*l.* per annum.

Respecting the second condition, curves not only increase the friction, retard the speed, and strain the engines, adding thereby much to the annual expense, but if they are sharp, induce in swift motions considerable danger by the centrifugal force tending to throw the trains off the rails. Economy and safety, therefore, exclaim loudly against short and sharp curvatures. It is difficult to assign the limit of admissible curvature; this will greatly depend on the velocity. All curves create friction and expense, but the danger will be proportional to the rapidity of motion. As a general rule, probably, no part of a railroad, not near a terminus, should have its radius of curvature less than from 1 to 1½ mile. In my experiments on the Manchester and Liverpool Railway last year, I could not help noticing the sensible effects on the speed and labouring of the engines, in different parts of the line, owing to its curvatures. These effects, too, are most felt when the rails work badly with a little wet, and in strong winds.

Our third condition—the avoiding of tunnels—is one of so much importance to the permanent success of a railway, that I confess I know not how to do justice to my feelings, and the experience I have had on the subject. To appreciate the nuisance of travelling in tunnels it must be witnessed; no description can ade-

* This is not mathematically true; the speed is not diminished a fourth, but somewhat less.

quately represent it. The instantaneous transition from the free and open air to the confined, damp, offensive atmosphere of tunnels, and from the full light of day to midnight darkness, rendered more visibly dismal by the glimmering of gas-lamps here and there, are certainly not among the greatest of tunnel nuisances, but yet are such as few, after one experiment, would like to repeat. Were I to endeavour to describe the pernicious effects on the human frame, and particularly on those of a delicate texture; of the differences of temperature in the open air and in tunnels, during winter and summer; or the deafening noise* of discarded steam against the top of the tunnel, and its numerous reverberations, or the annoyance of this steam filled with particles of coke scattered for want of vent with lavish prodigality over the train, my efforts would entirely fail. But what, allow me to ask, would be the consequences of an accident in the confined limits of a tunnel, a mile perhaps from either extremity, in the midst of darkness, and some 3 or 400 feet under the surface of the earth? Tunnels are, indeed, the greatest evils with which any railroad could be afflicted. Without one redeeming quality to set against the excessive expense† of their construction, or the dangers they create, they abound in nuisances for every one of the human senses.

On the Liverpool and Manchester Railway there are two tunnels, both at the Liverpool end. In each the instrument of traction is not a travelling but a fixed engine, with an endless rope! Hitherto, I believe, there has been no instance of a travelling steam-engine towing a train of passengers through tunnels. Whenever the experiment is tried, the inconvenience and annoyance will, I am satisfied, be found far too great for passengers to endure; and either steam-engines, in their present mode of application, or tunnels, must be abandoned. If, therefore, it be considered that passengers pay many times the tonnage of heavy goods, and that on the Liverpool and Manchester Railway they constitute 56 per cent. of the total returns, what, I submit, must be the prospects of any project in which, forming the chief item of profit, their convenience and comfort are outraged by the accumulation of insufferable nuisances? Far is it from me to wish to raise impediments to the formation of railways, convinced as I am of their utility, and, from the wants of society, of their necessity, I would much rather lend my humble assistance to forward them. All that I wish to do is, to furnish the general body of the public with a few hints to direct them in the choice of proper objects to support, that they may not, as but too frequently happens by disappointment in schemes injudiciously planned, be led to discountenance undertakings, which, bottomed in sound principles and conducted with skill, cannot fail to redound to their own profit, and the country's prosperity.

In my next I intend to commence an examination of the working capabilities of the various public railways sanctioned and planned out of London. Any information on the subject *(post paid)* to the author, will be thankfully received, especially that containing the particulars of their respective sections and map-lines.

JOHN HERAPATH.

Kensington, May, 1835.

THE PNEUMATIC RAILWAY.

Sir,—The only excuse that, I think, can be offered for the unnecessary warmth displayed by the projector of this monstrosity, is, that he has deceived himself into the belief of the practicability of his scheme. I know nothing whatever of Mr. Pinkus; but I am sure that I am not the only one who considers that he is wasting his money and his energies on one of the greatest absurdities ever submitted to the public. As your correspondent, Mr. Geo. Berry, has anticipated some practical difficulties to the Pneumatic Railway, which I had prepared for your inspection last week, let me now confine myself chiefly to one, which is, as I conceive, insurmountable;

* This may be experienced in miniature in passing under the arches of the viaducts. When experimenting I paid some attention to the annoyance of steam and coke, subsequently alluded to, which is generally so great as to prevent travelling outside, even in the open air, and I have little doubt of being able to remove it.

† I believe the ordinary expense is about 40*l*. per yard of length, or 1*l*. 2*s*. 8*d*. per inch. If the tunnel be like that designed at Box-hill, near Bath, 22 feet by 30, I am informed it will be about 60*l*. per yard, or 1*l*. 13*s*. 4*d*. (that is nearly the united fees of a learned conclave of one counsel and two attorneys) per inch.

I allude to the valvular opening, which, if I understand the description aright, is to extend through the entire length of the railway. Now, as the train of carriages is to be connected with the moving piston or diaphragm, by means of this continuous opening, one may suppose that it should be at least two inches wide. If we take a length of railway only a mile in extent, this valvular opening will present an area equal to 98 square yards. It appears to me that neither the projector nor the sponsor (Dr. Lardner) of the Pneumatic Railway, will be able to adapt a covering to this valvular opening that will permit the rarefication of the air contained in the cylinder. Dr. Lardner terms the covering a valvular cord, which, in plain language, means, I presume, a leather strap, properly prepared, and sufficiently flexible, to run easily over the drum of the governor. But who will take upon himself to ensure so perfect an adjustment of this leather strap, it being, say one mile in length, that it shall act at all times as a perfectly air-tight valve throughout its whole length—notwithstanding exposure to every kind of weather—to variations of temperature—to dust, friction, and many other impediments. I have often been told that gas-engineers, with all their care, find it very difficult to lay mains so that they shall be perfectly air-tight; and it is doubtful if there is a mile of main in the kingdom that would sustain, for one minute, an ich of mercury above or below the pressure of the atmosphere; and yet Mr. Pinkus proposes the partial exhaustion of a main whose diameter is to be 40 inches, with an opening on its top side equal, in one mile, to nearly 100 square yards, and covered only by a flexible leather strap!

I am, &c.

A.

May 18, 1835.

HOARE'S MODE OF CULTIVATING THE VINE.

A friend having suggested to me that, in my observations upon Hoare's Work on the Vine, the observation respecting grapes grown in the open air having been sold at 2*s*. 6*d*. per lb., must be an error, and that the grapes alluded to must have been grown in a hot-house. I lost no time in writing to my friend Clement Hoare on the subject, and having been favoured with the accompanying reply, and supposing it would be as interesting to many of the readers of the Mechanics' Magazine as to myself, I have sent it for insertion.

HENRY WATSON.

Chichester.

Sidlesham, May 19, 1835.

Dear Sir,—In answer to yours of the 2d instant, requesting to know if the statement inserted by you in the Mechanics' Magazine for the present month, respecting the price at which grapes grown by me on the open wall have been sold be correct or not, I beg to say that it *is* correct; and that, for many years past, a great portion of the black Hamburgh grapes, which I have disposed of at the latter part of the season, has realised the same prices, and has been sold as hothouse grapes.

With reference to your other question, as to the quantity of grapes which can be annually grown on a given portion of walling, I beg to remark, that not less than a pound weight to every square foot of the surface of the wall that is covered with the shoots of a vine can be deemed a fair crop, provided the vine be well established. I have many times grown nearly double that weight under very favourable circumstances; but taking the entire surface of a wall covered with vines, planted, pruned, and managed in the manner recommended in the Treatise on the Vine, which I have lately published, and which you have been pleased to notice in the above mentioned Magazine in terms of commendation, if there be as many pounds weight as there are superficial feet of walling, the crop may be deemed a good one.

Indeed, the certainty with which full crops of grapes can be always obtained, provided the bearing shoots be trained and managed in a proper manner, offers to every person, who possesses a little walling, a source of very considerable pecuniary advantage, as no fruit whatever, that can be grown in this country on the open wall, can for a moment be compared in value to grapes, when the sorts of the latter are good, and their culture judicious. And I am fully persuaded, that every cottage in the southern and midland counties of England, would annually realise for its occupier nearly, if not quite, its rental, were the

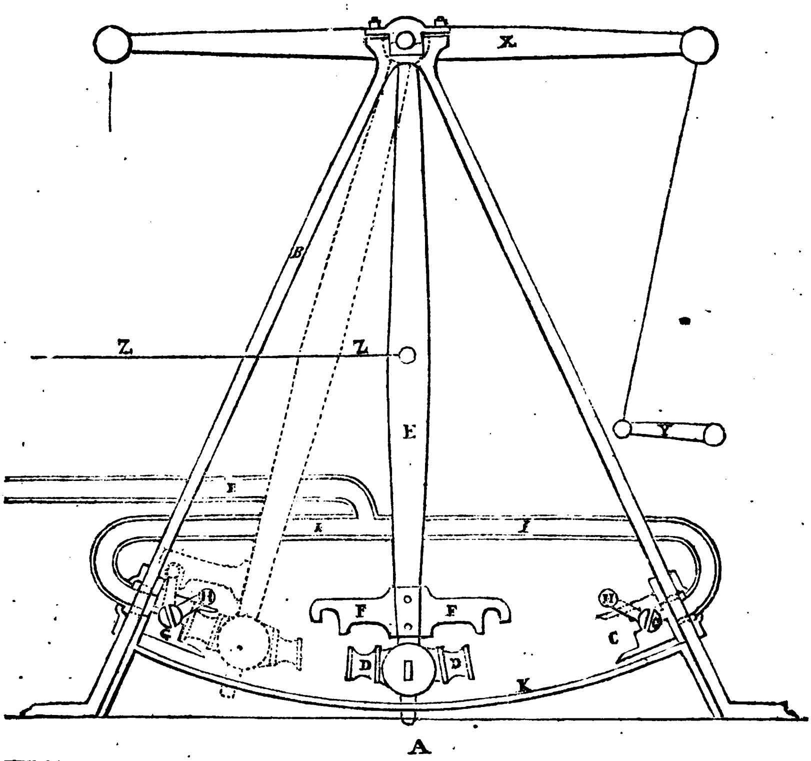
surface of its walls covered with well assorted vines, and the culture of these attended to in a proper manner.

Immense quantities of grapes are annually imported in steam-vessels from the continent, and sold in our markets at prices varying from ninepence to eighteenpence per pound; while precisely the same sort, and possessed of a higher flavour, could be produced in this country in an unlimited quantity, were the true nature of the vine and its capabilities better understood.

I remain, dear Sir,
Yours very truly,
CLEMENT HOARE.

Mr. H. Watson, Chichester.

PENDULUM STEAM-ENGINE.



Sir,—Encouraged by the readiness which you show to give publicity to all designs and suggestions that have any claim to originality, or are at all likely to be productive of practical good, I take the liberty of sending you a sketch of a new form of a steam-engine, which may be termed a pendulum-engine.

I made a model of an engine on this plan some years ago, and it answered very well; however, I did not then give it publicity, because I had hopes of being able to try its action on a larger scale; but, as an opportunity has not offered itself, I can only speak of it as a model. There are, no doubt, many defects in the plan; and to any of your scientific correspondents, who will do me the favour to point out such defects, and suggest any required improvement, I shall feel much obliged.

Description.

A is the foundation; B B, the frame; C C are two short cylinders, opposite to each other, into which swing the pistons at the end of the pendulum rod E, and to which is also affixed two catches, F F, for opening and shutting the steam-cocks G G, by means of the levers H H; I I I are the steam-pipes; K is a guide-plate for the pendulum-rod.

The action of the engine is represented by the dotted lines. As the piston vibrates into the cylinder, the short end of the catch passes over the lever, which is carried forward by the long end until the cock is opened; when the action of the steam causing the piston to return, the short end acts upon the lever until the cock is closed; and so on alternately.

The engine might be used for various purposes. Pumps could be connected by means of the cross-beam X, or a rotary motion communicated to machinery by the crank Y and a fly-wheel.

Should the engine be placed at a distance from the pumps, the cross-beam could be dispensed with, and a rod, Z, connected to the pendulum-rod, by which any length of stroke might be acquired by altering the point of connexion.

Should high-pressure steam be an objection, low-pressure could be employed by having two longer cylinders, the pistons being connected by one piston-rod, and the pendulum acting in the middle of it by means of a roller.

I am, Sir,
Your obedient servant,
CHARLES SOCKLE.

Ord-street, Mill-wall, Poplar,
Feb. 12, 1835.

M'CURDY'S PROPELLER.

Sir,—Believing that the object of your valuable, scientific Magazine is to elicit the truth, permit me to make a few remarks upon the objections that have been made by some of your correspondents to Mr. M'Curdy's Propeller, a description of which appeared in No. 607.

Scrutator Mechanicus advances, as an objection, "the great expense and difficulty of constructing such cranks of *wrought iron.*" This objection can hardly apply to that gentleman's cranks, as they were made of *cast iron;* a single pattern answered for the whole; each crank weighed about 150 lbs.; the throw of the crank was two feet; and the eight cranks, with four rods and four paddles, of iron three feet long, weighed about a ton. A workman, after the flanges were turned and fitted, put the whole together in a day; and the friction was so slight, that with one hand, and the purchase of a crank of twenty inches' throw at the extremity of the lower shaft, he could revolve the paddles dipping in the water twenty revolutions in a minute! Not a crank has ever yet broken or given way. It is easy to estimate the expense of such a propeller. Another objection made is the "great weight of the additional shaft." So far from this being the case, the additional shaft will not weigh as much as the eight additional arms and paddles of the common wheel, which are dispensed with in the propeller, besides bands, clamps, &c.

Scrutator's remark, that the originality of the invention is "more than doubtful," may as well be passed by, as a patent, I believe, has never been vitiated by a sneer!

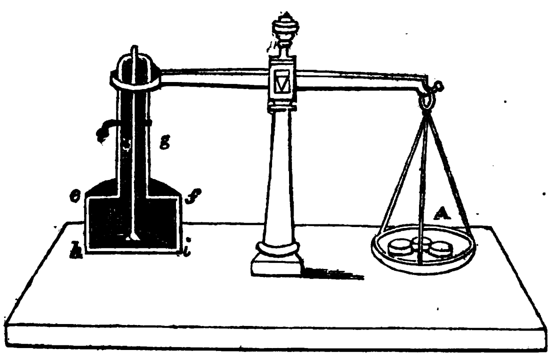
Another correspondent, who has done the invention the honour of a notice, says he "tried a similar invention, and was altogether unsuccessful; that he notices the same is patented by an American, and wishes him joy of his invention." To wish a man joy of a *failure* is very *charitable,* and must be sincere. The patentee might very well say, "thank you for *nothing.*" But I am compelled, from the very remarks of this correspondent himself, to infer that his propeller was *not* upon the same construction as Mr. M'Curdy's. His objections are as follows:—"1st, The great speed by which they must be driven, to make as many strokes as do the blades of the common wheel, and consequent greater amount of friction and weight." Now, sir, a crank of three feet throw, which your correspondent supposes this to be, describes a circle whose diameter is six feet, consequently its circumference will be eighteen; the crank, therefore, in describing a circle of eighteen feet, dips four paddles in the water, and in travelling fifty-four feet will dip in twelve paddles; which is the same number of paddles your correspondent supposes the Dundee steamer to dip in the water by the wheel moving fifty feet. But if we take the wheel to be eighteen feet diameter, the wheel and the propeller would dip the same number of paddles in passing through the *same space.* Your correspondent's se-

cond objection is, "The propellers, when making their return stroke, in a short head sea or ripple, must just produce as much effect to drive the vessel astern as the immersed one drives her ahead." A three-foot crank, we have shown, describes a circle whose diameter is six feet. Now, supposing the paddle to dip two feet, it will rise from the surface of the water four feet on its return; it would therefore be necessary, to produce the injurious effect described by your correspondent, that the vessel should heel sufficiently to dip or bury the paddle six feet under water; in which case I apprehend, not only the propeller but the wheel of the Dundee would be equally useless and inefficient. The third objection is, "The great additional breadth necessary, as Mr. M'Curdy's wheel is twelve feet broad, if the cranks have a three feet throw." Now, sir, I beg to state that Mr. M'Curdy's wheel is no such thing—the throw of the crank has nothing to do with the *breadth* of the paddles. On reference to the drawing, it will be seen that each paddle, in revolving, partly occupies the same space as the adjoining one; so that four paddles of three feet each in breadth, only require a space of about eight feet six inches to revolve in, instead of *twenty-four feet*, which has been so liberally allotted to them by your correspondent. I have seen Mr. M'Curdy's propeller in operation, and have no doubt, that, with a paddle containing *half* the superficies of one in a common wheel, it would be equally effective, as its action is at all times vertical, and there is no loss of power on entering or leaving the water.

I remain, Sir, &c.

FAIR PLAY.

USEFUL RESULT EXTRAORDINARY OF THE USEFUL KNOWLEDGE SOCIETY'S LABOURS.



Sir,—I perceive, from a recent Number of the Mech. Mag., that an ingenious Frenchman is about to take out a patent for that long-sought desideratum, the perpetual motion. Now, sir, as it happens that I have myself lately had the good fortune to achieve the discovery, you will, I hope, admit the propriety of allowing me to enter a caveat in your pages against any foreign rival's pretensions to priority—in case it should turn out, when he enrols his specification, that his method is the same as my own. Thus much, Mr. Editor, is due, even out of bare justice towards the claims of native talent!

My invention (the details of which I will not trouble you with at present) is founded on the principle of the hydrostatic paradox, as that principle is laid down in the first number of the Library of Useful Knowledge, as follows:—

"We have seen how the displacing any portion of a fluid by a solid, whatever be the weight of the solid, produces no difference in the weight of the fluid, provided it stands at the same height as before; and how raising the height of the fluid by plunging a solid into it, increases its weight. If the fluid is raised by pressing or forcing it upwards, in however thin a column, provided the vessel is kept full, and closed in all directions, the pressure of the fluid will be increased, *and the weight of the vessel will be increased*, although nothing whatever, either solid or fluid, is added

to it, or made to touch it. The cylindrical box *e f* (see fig.) has a tube *g* fitted into its top, and there is a wire D fitted to a plate D, the size of the inside of the box, and moving up and down in it, water tight. The plate being at the bottom *h i*, water is poured into the box, so that it rises to *e f*, but does not rise in the tube. It is then balanced by a weight in the scale A. If the wire C is drawn up so as to raise the plate, and force some of the water into the tube, the whole box and water will *weigh* more than it did; and to restore the balance, more weight must be put into the scale A. If the box is three inches diameter, every inch that the water rises in the tube will add above four ounces to the *weight* of the box and tube, whatever be the bore of the tube; for the *pressure* of the water in the box, *in all directions*, will be increased by the weight of a body of water whose height is the height of the water in the tube, and whose base is the extent of the surface of the water passing on the top *e f* of the box. Now the top being three inches diameter, its surface is about 7¼ square inches; and a body of water one inch high, and 7¼ square inches broad, is 7¼ cubic inches of water, which weigh about four ounces. Thus, raising the wire a foot, will *add three pounds to the weight of the water*."—*Library of Useful Knowledge, Hydrostatics*, p. 6.

It is by a very simple application of the principle thus set forth, that I propose to effect the desired object; and all I can see to wonder at is, that mankind should have been so long without discovering the grand arcanum, when so convenient a law of nature stared them in the face all the while. There are, indeed, some "roaring infidels," who venture to assert that there is no such law in existence, except in the pages of the tract published "under the superintendence of the Society for the Diffusion of *Useful Knowledge*." But can it, for an instant, be believed that so monstrous a blunder as the laying down, with all due pomp and circumstance, of such a non-existent law, could be truly laid to the charge of a learned body, with no less profound a philosopher than my Lord Brougham at the head of it, and whole scores of men of science of first-rate eminence on its committee? The thing is evidently quite out of the question. A friend of mine, indeed, who delights in throwing cold water on all plans of perpetual motion, did startle me a little by observing, that if the pressure of the water in the box were increased equally "in all directions," the upward pressure would exactly counterpoise the downward, and that, therefore, the "*weight* of the box and tube" would remain the same as before! There certainly appears to be something in this objection; but, if it were well-founded there would be an end at once to my grand project. That being the case, I prefer practice to mere theory, and devoutly believe that, as the committee-men of the Society would hardly allow their names to be paraded on the covers of the book as having "superintended" its composition, without having actually tested by experiment all the propositions it contains (and especially one so novel and remarkable as that in question), it is absolutely and literally true that the specific gravity of water, at a given moment, may be *one*, while in the next it may be a hundred, or a hundred thousand!

I remain, Sir,

Your most obedient servant,

F. H.

April 28, 1835.

EMIGRATION TO THE NEILGHERRY HILLS—INDIAN HAND-MILL—CULTIVATING SUGAR IN INDIA, &c.

Sir,—The 390th page of your twenty-first volume has just been forwarded to me by the post, and in it I regret to see a communication which has a direct tendency to discourage the emigration of settlers to the Neilgherry Hills. I know not whence "L." could have obtained his information, that "the greatest part of the land on the mountains is already appropriated," as when I was there in November last, there were several thousand acres of the richest land inviting occupation. His next assertion is more worthy of consideration, and I will endeavour to obtain more certain information on the subject; but from the inquiries which I have already made, and as far as I can recollect, the aborigines alone are taxed as mentioned by "L." I am nearly sure that the low-country natives, who almost exclusively cultivate potatoes, are exempt from taxation; and that the European inhabitants are, (or rather were when I wrote my last communication,) I am perfectly certain.

You will observe that in inviting the attention of agricultural emigrants to these hills, I never for a moment con-

templated their competing with the natives in the cultivation of grain; it is to the cultivation and production of European articles of necessity and luxury, that I would draw their attention. Whatever is required by the natives, is produced by them at so cheap a rate, that it would never repay an European for his labour and trouble; but, I again repeat my conviction, that a limited number of small farmers emigrating to these hills, would have no reason to regret the step they had taken, more particularly if they had a son, or other confidential agent, in whose hands they might trust their produce for sale at Cannonnore, Bombay, Madras, as owing to the dishonesty and pilfering propensities of the natives, Neilgherry potatoes, though they can be brought to Bombay at rs. 2 per maund, are not always obtainable for even 6 rs.

I will take a hint from your correspondent, and proceed from where he has left off.

The only mill in use in India for grinding corn is the hand-mill;* which consists of two circular stones, from fifteen to twenty inches in diameter. The centre of the upper or moveable stone is cut out, forming a hole four or five inches in diameter for the admission of the grain; across this hole a narrow piece of wood is fastened, in the centre of which is a small aperture to admit of the point of a wooden pivot, fixed in the centre of the lower stone; a small wooden handle is fixed near the outer rim of the upper stone. This mill is, according to its size, put in motion by either one or two women, which will probably recall to the recollection of your readers, Matthew xxiv. 41; and in almost every house at the hour of three or four in the morning, a traveller, as he passes through a native town, hears these poor victims of ignorance and barbarous customs commencing the labours of the day, and accompanying them with their montonous and unmusical songs.*

In making bread, the dough is kneaded with taree, which is used in the place of both water and yeast; and when made with care and good materials, the bread is not distinguishable from what is eaten in England.

An immense quantity of sugar-cane is cultivated in India, but by far the greater part is made into "gourr" for native consumption. In Bengal and in the vicinity of Hydrabad, excellent sugar-candy is prepared, though not quite equal to that imported from China: at Hundidroog, near Bangalore, the finest clayed sugar is manufactured; and I once saw a specimen of tolerable loaf sugar and sugar-candy, manufactured on the estate of a Parsee, in the island of Salsette, near Bombay; but these are exceptions to the custom of the country, which is as follows:—

In the middle of the cane-field is a pit, about twelve feet square and five deep, along the centre of which, three axles are fixed in a strong frame-work on three perpendicular rollers; the centre fifteen inches, the others one foot in diameter, and about five feet high, made of the wood of the tamarind-tree, on account of its great strength and hardness; two-thirds of the upper part of the rollers are formed with teeth which fit in to each other; the lower parts are smooth, and meet close together; the upper axle of the centre roller projects above the frame-work in which it is fixed: to the projection a lever is attached, which is drawn by two or four bullocks, and all the cylinders revolve with a creaking noise, which on a still night may be heard at two or three miles' distance. The canes having been cut into lengths of two or three feet, are passed between the first and second rollers, by a man stationed for that purpose, which having been returned to him through the second and third rollers are thrown aside; the juice is conducted through a hollow bamboo into an earthen vessel sunk in the ground at

* The only windmill I have ever seen in this country, is one at the town of Baypoore, near Calicut, on the Malabar coast, which was erected by the Bombay Government, twenty-five or thirty years ago, at an expense (it is said) of about four lacs of rupees, (40,000*l*. sterling,) for the purpose of sawing timber; it was found to go at a splendid rate for some time, and the harder the wind blew, the faster it revolved; but like the Dutchman with his self-moving leg, it was discovered, when too late, that a trifling error had been made in its construction, viz. how to stop it, or lessen its speed. It soon afterwards received some injury, and has ever since remained *in statu quo*, a monument of the folly of the Bombay Government.

* Grinding corn, as well as bringing water in earthen vessels from the nearest well, (vide Genesis xxiv. 13,) sweeping the house, plastering the walls and floor with "gobur," and cooking the food, are in India the exclusive duties of the female members of the family, while the remainder of their time is employed in spinning and weaving.

the bottom of the pit, whence it is carried in earthen pots to the boiler.

The boiler* is a circular copper vessel, the sides of which make an angle of about 67° with the bottom; it is from four to five feet in diameter, and from six to fifteen inches deep, which having been placed over an oblong hole in the ground fashioned for the purpose, the fire is fed with the pressed cane, and the juice boiled, until it assumes the appearance and taste of hard-bake or tom-trot, most probably well known to your juvenile readers; in this state it is sold in the bazaars as "gourr."

Yours, &c.

BERGEIN.

Guzerat, 1st Dec. 1834.

P.S.—I do not know in what part of the country your correspondent "L." may have been, as though I have travelled above seven thousand miles in different parts of India, I never yet heard of either the juice of the sugar-cane or oil being expressed by machinery turned by the hand.

ANTIS'S IMPROVED CHIMNEYS.

Sir,—If the following paper, abridged from *Hazard's Register of Pennsylvania*, will tend at all to a discontinuance of the revolting practice of employing climbing boys in chimneys, I shall be happy to see it in your valuable and instructive publication.

Yours faithfully,

A. Z.

To construct a chimney which would carry smoke, has been found in practice one of the most precarious objects of mechanism. So little has the theory of smoke and draught been understood, that if ever a chimney was constructed to draw well, it was evidently a matter of accident; for no mechanic seemed to have any rule for constructing chimneys, which would ensure a good one. We have been extremely gratified within a few days, by the inspection of a flue, and a set of fire-places, constructed upon a plan entirely new in principle, invented by Mr. Henry Antis. We had not the pleasure of seeing Mr. Antis's model; but we saw the practical effect of his discovery, by a chimney and fire-places in operation, in the house of Mr. Joseph Wallace, in Front-street; the success of which is complete, and triumphantly sustains Mr. Antis's theory on the subject. His theory is, that cold atmospheric air tends to the centre of gravity till it meets with some obstruction, which gives it another direction; that heated or magnified air is exactly vertical in motion; that hence the flue to carry it off should be perfectly vertical, and in no place of smaller dimensions than at the bottom or first inlet. He maintains that it matters not how many inlets there be to it, provided the area of a cross section of the flue be equal to those of all the inlets combined; it may be greater, but must never be smaller. He, therefore, starts with a single flue from the cellar, regulating the size, to cover the area of all the contemplated inlets from bottom to top. He carries it up, all the way of the same size, in exact perpendicular direction; nor need the wall be more than the width of one brick in thickness. Wherever he wants a fire-place, he attaches jambs of the usual shape, leaving the common perpendicular wall of the flue for a back; throwing an arch across, at the proper place, in the usual form, covering it tight to the back wall. Immediately opposite, or below the covering of the arch, he leaves a horizontal aperture in the flue, the whole width of the fire-place, from jamb to jamb, in size according to calculation previously made, and according to the height of the arch; which for jambs from twenty-four to thirty inches high, must not be less than three inches perpendicular in the opening.

There seems to be philosophy in this theory; and practice, so far as tried, proves that there is truth in it; and we have no doubt the plan will, on a little further trial, be universally adopted by builders.

Beneath each grate, fitted in a fire-place, is an opening left, which descends obliquely into the flue. In this opening, on a level with the hearth, is a fire-grate fixed, through which the ashes descend from the grate above. And such is the effect, that while a strong current of air is produced, by the heat from the fire in the grate, through the horizontal aperture above, a moderate draught is also maintained in the oblique one below, which carries off all the dust; so that from a coal fire, not a particle of dust escapes into the room. He also affixes a valve to each inlet, hung in such an ingenious manner, that the mere pulling of a small brass knob closes it entirely; and thus, in case the chimney should take fire, all the currents of air may be stopped in a moment, and the fire dies at once. Not a particle of soot can ever enter your room or your fire-place; for that, as well as the ashes, all descend to the bottom

* In the Southern Mahratta country, during the rains, these vessels are used as ferry-boats on the numerous rivers which intersect the country; in August, 1632, I actually saw eight men safely ferried across the deep and rapid, though narrow river Malpurbar, in a *saucepan* of the above description.

of the flue in the cellar, where an opening, with a sheet-iron door, is constructed, from which these articles can be taken; and through which a sweep may enter and perform his duties, without disturbing the business, or amusements, or quiet of any part of the family. Where necessary, he also carries up side flues in the jambs, by which air can be introduced, to regulate the temperature of your room, or the force of your draughts.

The advantages of this improvement are,

1st. Fewer materials are used, which cheapens the work.

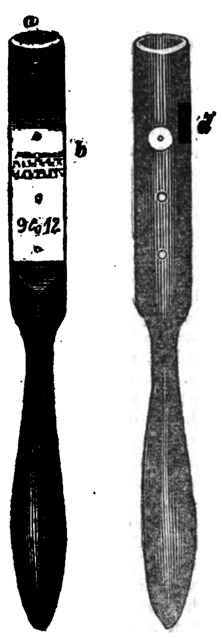
2d. Less room is engrossed by dead brick-work.

3d. No annoyances from soot or ashes in your rooms—not even when a sweep ascends to clean out your flue.

4th. Power to regulate the temperature of your rooms, without opening doors or windows.

5th. Perfect security against smoke, in every room in your house.

THE NEW INVENTED NEEDLE-THREADER.



Sir,—The accompanying sketch represents a highly valuable auxiliary for such of our female friends as find their unassisted eyes inadequate to the performance of that delicate operation, without which there can be no fine needle-work.

Needle-threaders, of an expensive and somewhat inconvenient form, have been in use for some time; but in the little instrument now before me, from the celebrated manufactory of Messrs. Joseph Rodgers and Sons, of Sheffield, a very superior and convenient machine has been produced at a cheap rate. Fig. 1 is a front, and 2 a back, view of this threader; it consists of an ivory stem or handle, with a hole at the top *a* to receive the needle; *b* is a spring steel plate which holds the needle firmly in its place during the operation; *c* is a hole in the steel plate where the thread comes through.

To thread the needle, put it with the eye downwards (and in the direction of the thread-holes) into the hole *a* at the top of the threader, pressing it down as far as it will go. Having prepared the thread in the usual manner, put it through the wider hole *d*, being careful not to hold it in a slanting direction, either upwards or downwards; from the tapering form of the entrance to the hole *d*, the introduction of the thread is accomplished with great facility and certainty. This hole being left white, while the other parts of the ivory are coloured, renders it easily distinguishable in a very indifferent light.

These threaders are made of two sizes, marked 4 to 8, and 9 to 12, respectively, which will suit needles of those numbers. Some are made double to suit all needles, having the fine threader at one end and the coarser one at the other.

I have used this instrument myself (experimentally only), and have received such unequivocal testimonials of its usefulness, from several of my female friends, that I think they cannot be too extensively made known, for the benefit of all who need their friendly aid.

They are a pretty addition to the work-table, and fully answer their intended purpose.

I remain, Sir,
Yours respectfully,
WM. BADDELEY.

London, May 20, 1835.

REMARKABLE ACTION OF PLATINA ON OXYGEN AND HYDROGEN.

Sir,—My attention has just now been called to a curious fact, disclosed by Dr.

Faraday, of which I should like to see a good explanation. If Mr. Cheverton will condescend to effect this on any theory whatever, not involving hypotheses purposely devised, he shall have my best thanks, and in return an attempt to explain it by the new theory. I am necessarily confined to few principles, while he can expatiate in the vast amplitude which the present philosophy allows. The fact is this—if a plate of pure platina be immersed in strong but sulphuric acid, and then washed in distilled water, and put into a mixture of oxygen and hydrogen gas, in proportions as found in water, the gases will combine gradually till the plate becomes red-hot, and at last the gases will explode; the combined gases will run off the plate in the form of water, or escape in aqueous vapour.

I am, Sir, yours truly,

THOMAS EXLEY.

P. S.—In my answer to Mr. Cheverton's remarks on my Theory are two errata, which it will be important to correct as soon as possible; the first gives a sense contrary to that intended :—

P. 117, col. 1, line 15 from bottom, for "my," read "*no.*"

P. 118, col. 2, line 20, for "enamelled," read "unannealed."

Also same column, line 35, for "pp." read "ph;" and for "lecture," read "section."

LIST OF NEW PATENTS, GRANTED BETWEEN THE 22D OF APRIL, AND 22D OF MAY, 1835.

Reuben Earnshaw, of Huddersfield, in the county of York, dyer and chemist, for a certain improvement, or improvements, in preparing and working wool for making or manufacturing various fabrics. April 25; six months to specify.

James Stevenson, of Leith, merchant, and John Ruthven, of Edinburgh, mechanician, for a method of cutting wood by certain improved instruments. April 28; six months to specify.

Charles William Rowley Rickard, of Thistle-grove, Kensington, engineer, for certain improvements on boilers applicable to steam-engines and other purposes. April 28; six months to specify.

William Simpson Potter, of Verulam-buildings, Middlesex, merchant, for certain improvements in rendering fabrics water-proof, being a communication from a foreigner residing abroad. April 28; six months to specify.

John Somerville Clerk, minister of Currie, county of Edinburgh, for certain improvements in the construction of guns or muskets, and other such fire-arms. April 28; six months to specify.

Isaac Dodds, of Horsley Iron-works, county of Stafford, engineer, for certain improvements in the construction of fire-arms, part or parts of which improvements may be applied in the making and using of common and other ordnance. April 30; six months to specify.

John Reynolds, of Oakwood, near Neath, county of Glamorgan, iron-master, for certain improvements in railways. May 5; six months to specify.

William Simpson, of Evesham, jobbing smith, for a safety drag or lever slide for carriages. May 9; six months to specify.

Joseph Egg, of Piccadilly, gun-maker, for improvements in certain descriptions of fire-arms. May 9; six months to specify.

Alphonse Humbert Jean Francois Valois, of Lyons, in France, but now residing at No. 9, Artillery-place, Finsbury-square, gent., for a certain improvement or improvements in the mode or method of producing engravings, etchings, or reliefs, on metallic plates (for producing impressions therefrom), and in the apparatus used in same. May 13; six months to specify.

Thomas Dunkin, of Bordeaux, in France, but now residing at No. 2, Trinity-place, Charing-cross, late officer in the 18th regiment of Hussars, for certain improvements in the mode, method, or system of obtaining or producing duplicate copies of manuscripts, writings, and drawings, and in the apparatus or machinery used in the same. May 13; six months to specify.

Charles Chubb, of St. Paul's Churchyard, patent lock-manufacturer, for certain improvements in the means of making secure receptacles for property, such receptacles being either fixed or transportable, and being such as are usually called strong doors, safes, chests, and boxes. May 13; six months to specify.

Henry Dunington, of Nottingham, and William Copestake, of Stapleford, both in the county of Notts, lace-manufacturers, for certaim improvements in making or manufacturing lace. May 13; six months to specify.

John Buchanan, of Ramsbottom, county of Lancaster, millwright, for certain improvements in the construction of cylinder printing machines, used for printing paper, calico, and other fabrics. May 13; six months to specify.

Pierre Frederick Fischer, of Great Marlborough-street, county of Middlesex, merchant, for certain improvements on piano-fortes, being a communication from a foreigner residing abroad. May 13; six months to specify.

John Ody, of the Strand, Middlesex, patent truss-manufacturer, for an improved construction of water-closets. May 13; six months to specify.

Charles Schafhault, of 77, Cannon-street, London, gentleman, for an improvement in the mode of manufacturing malleable iron. May 13; six months to specify.

Alexis Dumoulin, of Leicester-square, merchant, for certain improvements in gas-apparatus. May 19; six months to specify.

William Patterson, of Dublin, gentleman, for a new material for tanning hides and skins, which is also applicable to other purposes. May 20; six months to specify.

INQUIRIES.

Quantity of Rain that falls in London.—Sir, One great advantage your valuable work possesses is, that by means of it questions may be asked and information obtained on various scientific matters; and it is due to you, sir, and to your numerous friends, to assert, that information is but rarely sought for in vain. May I then avail myself of this generous feeling, to request to be informed, through your Publication, what is the greatest depth of rain known to have fallen in the neighbourhood of London in twenty-four hours? A late eminent engineer considered the maximum quantity fallen in any twenty-four hours to be one inch in depth; but as that is a much greater quantity than has been given in any accounts I have seen, and as I do not know upon what authority

that depth was assumed, I doubt its accuracy.—I am, Sir, your obedient servant, PLEUVOIR.

Tables of Acreage.—"A Constant Reader of the Mechanics' Magazine," would be much obliged to any of its correspondents, who would direct him to some book wherein he can find calculated tables of acreage, according to both customary and statute measure.—*Nov.* 7, 1834.—[We have to apologise to the author of this inquiry for having so long overlooked it.]

Brick-making. — Having lately commenced throwing up clay for "brick-making," I find buried in the clay small blue stones, which in this part of the country are called lime-wash, and are considered very detrimental to the quality of the brick. I should be glad to know how these ill effects are to be obviated, and whether it may not be done by grinding or tempering the clay in a mill? If this should be the case, I would further like to know what description of mill could be turned by horse-power, and where it may be procured.—A BRICKMAKER.—*Shrewsbury, March* 2, 1835.

Windmills.—"A Reader of the Magazine" in Antwerp, has desired me to request insertion of the following query:—What are the dimensions required for a horizontal windmill of two-horse power? Perhaps some of your numerous and well-informed correspondents will furnish my friend with an answer to his inquiry. Any information regarding the most improved mode of grinding lac-dye and indigo, would be also very acceptable.—E. HENDERSON.

Gas-lighting. — Sir, Feeling the charges made by a Gas-Company here to be very exorbitant, having for this last quarter paid no less than 26*l.* for the gas my single manufactory has consumed, I am desirous of eliciting from your very respectable and intelligent correspondents, whether it would not be more economical for us to erect the necessary apparatus for affording a competent supply within our own property? I am particularly desirous of ascertaining what would be the probable expense of the apparatus necessary for producing gas sufficient for about twenty lights, and the average outlay per annum for repairs, &c. &c. Although coal is lower in price here than probably any other part of the country, yet the gas made from it is, I suspect, much dearer. To give you an idea of the extravagant returns of the Gas-Company, I need only say that their dividends average from 10 to 12 per cent. Our hours are from six in the morning to six in the evening, and it is only on urgent occasions that we keep the works open beyond that time.—Yours, Sir, A CONSTANT READER.—*Newcastle-upon-Tyne, April* 6, 1835.

White's Ephemeris.—Sir, I have purchased a copy of White's Ephemeris for 1835, for the purpose of assisting my young folks with their exercises on the globes; being but an indifferent astronomer, or rather, no astronomer at all; but I must confess I do not understand the proper mode of using the tables given in the above work. Mrs. Bryan, in her excellent Treatise on Astronomy, has given a Key to White's Ephemeris, such as it was in 1805; but she falls far short of assisting an humble inquirer like myself in the use of the work in its present improved form. May I, therefore, take the liberty of asking whether there is any book published giving a full account of the Ephemeris? Should there *not* be any, it would be rendering me, and no doubt many others, an essential service, if any of your intelligent mathematical correspondents would, in a clear and explicit manner, describe the nature and use of the several columns in *any one month*, as they stand in the present impression.—I am, Sir, yours truly, CADOGAN.—*Knightsbridge.*

NOTES AND NOTICES.

Inland Transport.—I should be much obliged if you would inform me whether it is true, as asserted by Mr. Edward Sang, in the Mech. Mag. for January last, "On the Progress of Man in the Useful Arts," and on what authority the assertion is made, "That the projectors of a canal, or of a railway, are taken bound to make up any loss that may be sustained by the trustees on the ordinary road?"—A CONSTANT READER.—We are not aware of the existence of any *general* rule to this effect, and believe Mr. Sang is mistaken. Where a turnpike-trust happens to be in debt, it is not unusual to protect the creditors in the way Mr. Sang mentions, and is, indeed, no more than fair; but as such trusts are not created for the private benefit of trustees, or any set of individuals whatever, but for the benefit of the community at large, no loss can arise to any trust (leaving creditors out of the question), from the establishment of a canal or railway, which does not merge in the greater gain to the public.

Isometrical Perspective.—Sir, Your readers probably recollect the remarks I made on R.'s "Perspective of the Press" (vol. xix. p. 295), and the controversy in which that projection was particularly noticed. Since then Mr. Sopwith's work has appeared, containing several figures in that sort of projection; and J. R., in the "Architectural Magazine," having made some remarks thereon, it has led to a little skirmishing between him and Mr. Sopwith. It will be seen from these papers that R. was not alone in the opinion he once entertained, and that J. R. makes use of my reasoning in his controversy with Mr. Sopwith. At present I shall not make any observations on their respective statements, but content myself with directing attention to these papers, as they may tend to impress a correct knowledge of projection on the minds of many young draughtsmen, which J. R. gives us reason to suppose few of them possess.—I am, Sir, your obedient servant, JOSEPH JOPLING, 31, *Somerset-street.*

Mr. G. J.'s very useful communication has been forwarded, agreeably to the apparent intention of the writer, to the gentleman who has the subject it treats of in hand.

Communications received from Mr. Wrigg—M. al, M.—Mr. Tinte—E. S. L.—A Constant Reader—A. M.—A Countryman.

The Supplement to our last Volume, containing Titles, Index, &c., with a Portrait, on Steel, of Samuel Clegg, Esq., C. E., is now published, Price 6*d.*; also the Volume complete, in boards, Price 8*s.* 6*d.*

Our Publisher will give One Shilling and Sixpence for copies of the Supplement to Vol. IX.

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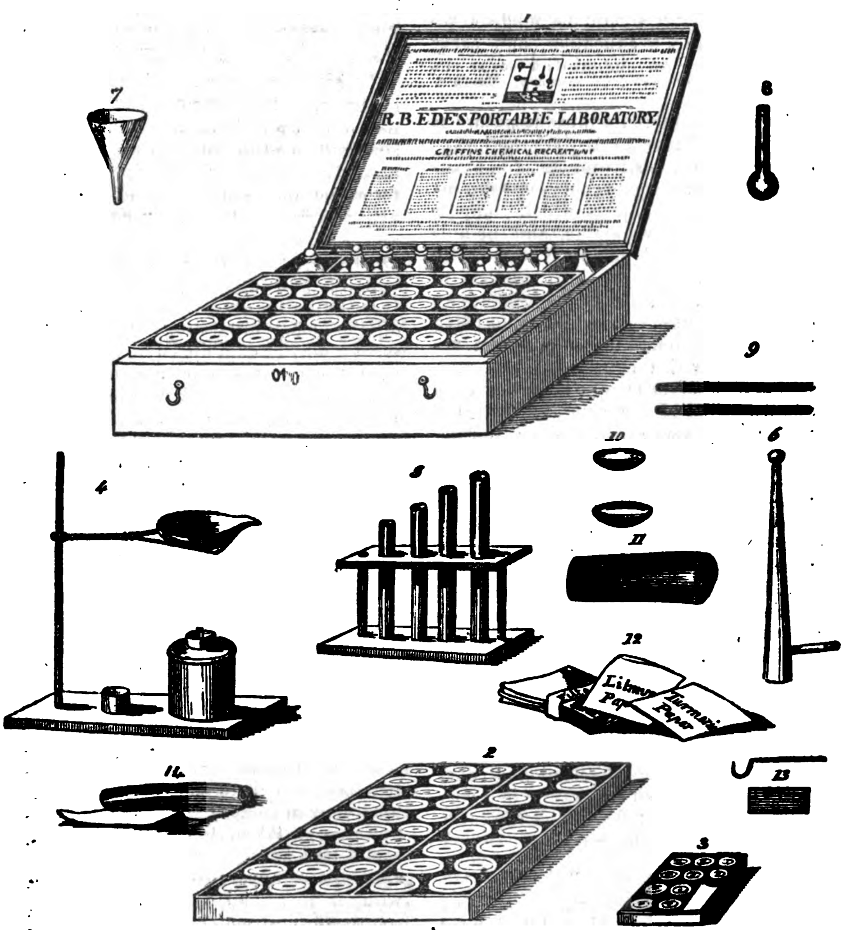
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 617. SATURDAY, JUNE 6, 1835. Price 3*d*.

EDE'S PORTABLE CHEMICAL LABORATORY.



EDE'S PORTABLE CHEMICAL LABORATORY.

"The facility with which chemical inquiries are carried on, and the simplicity of the apparatus, offer additional reasons for the pursuit of this science. All the implements necessary to the philosopher may be carried in a small trunk."
Sir Humphry Davy.

Sir,—It would be altogether superfluous to attempt at this period to adduce many arguments in support of the importance, or advantages, of chemical knowledge. PARKES very justly observes, that "chemistry should be made a regular branch of education, and every youth should be acquainted with its rudiments.

In man's researches into the nature of the things whence he derives the means of his comfort, his happiness, his luxuries, and even his existence—in examining the various objects which compose the mineral, the vegetable, and the animal kingdoms, chemistry is essentially requisite for the successful progress of his inquiries. It, therefore, becomes an object of the utmost importance, to place the means of obtaining a *practical* acquaintance with this useful and interesting branch of science within the reach of all classes of the community. It is now nearly seven years since I commenced a series of articles on "Cheap Chemical Apparatus," which appeared in your tenth volume, but which I was unavoidably prevented from pursuing beyond the third paper. Since that time, however, my silence on this topic has been more than compensated for by the valuable practical papers of Mr. Weekes, and other of your talented contributors.

The subject is altogether one in which I take a deep and constant interest, and it is with peculiar pleasure that I now return to it, for the purpose of noticing a convenient and useful selection of chemical materials and apparatus, in a very neat and compact form, recently introduced by a scientific gentleman.

In Lord Brougham's "Practical Observations on the Education of the People," he observed, "a friend of mine is at present occupied in devising the best means of simplifying apparatus for lectures upon the mechanical powers; and cheap chemical laboratories may then receive his consideration." So far as "simple apparatus for the illustration of lectures on mechanical philosophy" is concerned, we are no better off now than when Lord Brougham wrote the pamphlet alluded to. With respect to chemistry, however, we are in a much better situation, through the instrumentality of Mr. Robert Best Ede, a chemist of considerable note at Dorking, Surrey, whose skill, assiduity, and taste, in producing, in an elegant and convenient form, many of the most useful and agreeable chemical compounds, has procured for him the special patronage of her Majesty.

It has been often and most truly observed, that the notion that a laboratory fitted up with furnaces and expensive and complicated instruments, is an absolute requisite for the proper performance of chemical experiments, is exceedingly erroneous. "For general and ordinary chemical purposes," says Dr. Henry, "and even for the prosecution of new and important inquiries, very simple means are sufficient: some of the most interesting facts of the science may be exhibited and ascertained with the aid merely of Florence flasks, of common phials, and of wine-glasses. In converting these to the purposes of apparatus, a considerable saving of expense will accrue to the experimentalist, and he will avoid the incumbrance of various instruments, the value of which consists in show rather than real utility. It is a curious and highly-instructive fact, that some of the most important discoveries in chemistry were made by persons who either from choice, or motives of economy, employed utensils of the very simplest character. The laboratory of the great Priestly cost a mere trifle; and it is well known how savingly Franklin went to work."

Fully convinced of the truth of these remarks, Mr. Ede has arranged in a handsome mahogany box, 12 inches by 9, upwards of 90 of the most select and useful tests and re-agents, together with appropriate apparatus for performing with facility and safety an extended course of instructive and entertaining experiments, particularly in reference to the principal class-experiments exhibited in chemical lectures, which are pretty fully explained in Griffin's Chemical

Recreations,* and also for the analytical examination of minerals, salts, metallic oxides, &c.

The engaving on the front page exhibits the plan and contents of Mr. Ede's portable laboratory, which are as follows:

No.
1 The Laboratory open
2 The Tray of Boxes taken out of the Laboratory
3 Small Boxes placed at the bottom of ditto
4 Retort-Stand, complete with Lamp and Evaporating-Dish
5 Set of Test-Tubes and Stand
6 Dr. Black's Blowpipe

No.
7 Glass Funnel
8 Bulb-Tube
9 Two Glass Rods
10 Two Watch-Glasses
11 Charcoal
12 Packets of Litmus, Turmeric, and Filtering-Paper
13 Platinum Hook and Foil
14 Roll of Tin Foil

All of which pack very conveniently within the small box, and leave a clear space under the tray of the laboratory, measuring nearly 11 inches by 3, for the results of experiments, a box of scales and weights, or any other useful addition. The following is an alphabetical list of the chemicals and re-agents, numbered to correspond with the bottles and boxes, every one of which is distinguished by a neat green label, bearing in legible characters the name of the contents, and numbered, viz.:—

No.
15 Acetate of Lead
16 Alum
17 Antimony, Sulphuret of
31 Arsenic
61 Benzoic Acid
1 Bleaching Powder
18 Black Oxide of Manganese
19 Brazil Wood
32 Bi-chromate of Potass
33 Bi-carbonate of Potass
34 Borax
62 Boracic Acid
63 Bismuth
6 Bi-sulphate of Potass
64 Calomel
2 Carbonate of Ammonia
3 Carbonate of Potass
35 Carbonate of Magnesia
25 Carbonate of Soda
4 Caustic Potass
36 Chloride of Barium
37 Chlorate of Potass
5 Chloride of Cobalt
65 Corrosive Sublimate

No.
66 Cochineal
67 Cinnabar
20 Copper Wire
38 Copper Turnings
39 Cream of Tartar
40 Cudbear
21 Fluor Spar
41 Galena
42 Granulated Tin
43 Granulated Zinc
44 Gum Arabic Powder
68 Indigo
7 Iodide of Potassium
45 Isinglass
22 Iron Wire
46 Iron Pyrites
8 Lime
69 Litharge
70 Litmus
23 Logwood
9 Mercury
47 Microcosmic Salts
48 Muriate of Ammonia
49 Nitrate of Barytes

No.
10 Nitrate of Copper
24 Nitrate of Potass
50 Nut Galls in Powder
11 Nitrate of Silver
12 Nitrate of Strontian
56 Oxalate of Ammonia
51 Oxalic Acid
52 Phosphate of Soda
13 Phosphorus
53 Prussiate of Potass
71 Platinum Hook and Foil
54 Red Lead
26 Sulphate of Copper
27 Sulphate of Iron
28 Sulphate of Magnesia
29 Sulphate of Potass
30 Sulphate of Soda
55 Steel Filings
58 Super-oxalate of Potass
57 Sulphur
59 Tartaric Acid
14 Tincture of Galls
60 Turmeric Powder

Some few persons have thought the laboratory got up on too small a scale, but for my own part I must beg leave to differ entirely from such an opinion; for, taking all the circumstances into consideration, I believe it will be found that the size adopted by Mr. Ede is unquestionably the best that could be employed. Perhaps, neither the size of the apparatus nor the quantity of the materials are adapted to the purposes of a public lecturer addressing large audiences, but for private experimental research both are amply sufficient. The whole is upon a much larger scale than the apparatus which Dr. Wollaston usually employed, and with which he performed many interesting experiments, and made some of his most important discoveries. The fact is, that the chemical properties of a substance characterise equally the smallest portion of that substance, or the greatest mass. That which can be demonstrated of a pound can also be demonstrated of a grain. The chemical student will always find it of importance to operate upon extremely small portions of matter, for he will then not only save time and money, but often be enabled to perform a successful experiment, where,

* Chemical Recreations, &c. &c. By John Joseph Griffin. 18mo. Pp. 372. R. Griffin and Co., Glasgow; and Tegg and Son, London.

by operating upon a large mass, he would almost as certainly fail. The preparation of the gases, the formation and crystallisation of salts, the application of tests, and a thousand other entertaining and instructive experiments, can all be performed by the student, better upon a small scale than in the large way; nay more, a student in his closet very frequently succeeds in performing an experiment which fails on the lecture-table of the professor; for the accidents which attend the hurry and business of a lecture-room produce unavoidable disappointment.

Mr. Ede has been favoured with many highly flattering testimonials from the first professors of the day, who have pronounced his laboratory to be "a cheap,* judicious, and very useful selection, both of apparatus and materials, for students in experimental chemistry." It is got up in a style of great elegance, and is well calculated to supply a desideratum long wanted in the chemical world; it is a popular article, by which all classes may possess the means of acquainting themselves with the mysteries of chemical knowledge.

The unexampled success which immediately attended the introduction of Mr. Ede's laboratory, induced unprincipled persons to get up some paltry imitations of it, which, like most other imitations, fall far short of their prototype: these are evils, however, which inevitably work their own cure in time.

The ingenious student will soon perceive, that by slight additions to the laboratory, its powers may be readily extended through a wide range in the field of experimental chemistry. I would, however, suggest to Mr. Ede, the propriety of bringing out, with all convenient speed, *a second part* of his laboratory, containing a selection of apparatus and materials, arranged more particularly for performing the most ordinary and useful experiments in pneumatic chemistry. This would make the subject very complete, and afford the means of studying, in practical detail, all the important truths which it is the office of chemistry to develope.

All those persons who can understand and fully appreciate the important advantages that must necessarily arise from a wide and general dissemination of scientific knowledge, especially of chemistry, will feel, that in the production of his laboratory, Mr. Ede has rendered an important benefit to society, and conferred no small obligation upon the age in which we live.

Wishing him all that success which his exertions in the cause of science so richly merit,

I remain, Sir,

Yours respectfully,

WM. BADDELEY.

London, May 25, 1835.

* The price is 1*l.* 11*s.* 6*d.*; or with stopped bottles, French polish cabinet, lock and key, 2*l.* 2*s.*

THE PNEUMATIC RAILWAY—ANOTHER CLAIMANT.

Sir,—Your Magazine, No. 612, contains an account of a Pneumatic Railway, said to be invented by Mr. Henry Pinkus. In 1832, I was in correspondence with the Liverpool and Manchester Railway Company, relative to their adopting a plan I had invented, of forwarding their carriages by means of air-pipes and stationary engines; the carriages to move outside of the pipes, as in Mr. Pinkus's plan. Since then I have submitted my plan to the Company; I, therefore, conclude I am entitled to the merit of the invention, if there is any merit in it.

I proposed to the Company that the air should be compressed; Mr. Pinkus proposes it should be rarefied; but this makes no essential difference in the plans. The only reason I had for proposing the compression of the air rather than its rarefaction, was, from being enabled by this means to obtain a greater power with a smaller pipe, and thus save expense. I provided a means to regulate the power to the load, or inclination of the plane; and did away, almost in the strict sense of the words, with the friction that must necessarily arise from the air in the way Mr. Pinkus proposes to apply it. Were it not for the doubt existing as to the possibility of managing a column of air miles long, I should have faith in the practicability of the plan; but until those doubts are removed by a well authenticated successful experiment, I cannot but conclude there is a difficulty lies in the way, which makes me more than doubt the possibility of putting the plan into practice, at least in the manner proposed by Mr. Pinkus. Remove these doubts, and I will at once

agree that stationary engines may be made applicable by a column of air to railway transit; but even then it must be applied, if effectively, in a manner very different to that proposed by Mr. Pinkus; for I am of opinion, with your correspondent, Mr. Berry, that the "tunnel must be entirely cleared of air to cause the load to move through the whole length." This is practically impossible in such a work.

I have not the slightest doubt but stationary engines might be made to propel carriages on railways, &c.; and I intend to propose a plan to effect this, which I feel certain will be generally admitted as perfectly applicable to the purpose, of little expense, and simple in its management. It is a power with which most persons are familiar.

I am Sir,

Your very obedient humble servant,

William Kersall Wrigg.

Macclesfield, May 23, 1835.

BERNHARDT'S PATENT WARMING AND VENTILATING PROCESS.

Several indistinct notices have appeared in the newspaper press, both domestic and foreign, during the last twelve months (and some, it must be confessed, of rather a high-coloured description), of a new mode of warming and ventilating, stated to have been discovered by Mr. Bernhardt, a Saxon architect of considerable eminence, and exemplified by him with extraordinary success in a number of public buildings on the continent. As Mr. Bernhardt has taken out a patent in this country for his invention, and the time for his specification has now nearly expired, we shall soon be enabled to lay the whole particulars of his plan before our readers; but in the meanwhile, the following extracts from a statement authenticated by the signature of Professor Schaeffer, of Dusseldorf, may be accepted as good evidence that Mr. Bernhardt has actually arrived at some results of more than ordinary importance—one of which, at least, is, even in this country, of high mechanical invention, still a great desideratum, namely, *smoke without soot*. A late distinguished physician (Sir George Tuthill) has left it on record as his deliberate opinion, that the excessive quantity of carbonaceous matter sent forth into the atmosphere of London from its innumerable coal fires, is the grand cause of its unhealthiness, as compared with places in its near vicinity.

"The Royal General Post-office built, many years ago, a factory adjoining the post-house, for the repair of the mail-coaches, and since the building of the diligences and the increase of business, it has become a very large coach manufactory, in which above seventy workmen are at present daily employed. In a building at the back, arranged for the purpose, a forge for ten fires was put up and erected in the usual form. Smoke and soot penetrated into the dwellings of the neighbours, and rendered them uninhabitable and worth no rent. Complaints arose, and an expensive law-suit, which naturally terminated to the disadvantage of the Post-office department. Experiments were then made to clarify the smoke and separate the soot. The Prussian consul in England—that land of invention—was desired to make inquiries whether any means were known to remedy the evil, but nothing could be done; and the most learned professional men doubted the possibility of an invention to answer the purpose, because it was believed that any attempt to separate the smoke from the soot could only be made at the expense of the draught. It became a point of consequence to the Post-office authorities here, to satisfy the neighbours at any price, and they endeavoured to suppress the nuisance arising from the soot by removing the smithy into an intermediate building constructed for the purpose, the result of experiments by several artists, in inventing an apparatus by means of which it was hoped to banish the soot. A cistern of water was applied over the roof, which was intended, by being placed round the outlet for the smoke, to absorb its heavier parts; but the soot soon covered the water with an incrustation, and the finer particles of the soot escaped from the chimney and covered the gardens of the neighbours; besides the smoke spread itself throughout the smithies, so as to be dangerous and insupportable to the workmen at the fires. At that time the architect, Mr. Bernhardt, of Saxony, was in Berlin, and had been employed in the Royal Palaces; having devoted the whole of his life to the study of the deficiencies at present existing in the construction of fires, he was enabled to correct the similar faults in the General Post-office buildings, and his plans were crowned with the best success. Mr. Bernhardt discovered the means of forcing the draft of the smoke, and separating the

soot from it. His plans were carried into execution. *In a short time, without any interruption to the business of the coach factory the work was completed. The smoke ascends in a purified state through two cylinders of zinc to the roof, and the soot remains in the interior of the three story high building, concentrated in separate channels and chambers for it.*

"It is remarkable to observe the soot depositing itself in coarse particles, and afterwards becoming gradually finer as it ascends;—to see the smoke rising through narrow wire nets. In the channels of the five chimneys a mass of 26¼ cubic feet of soot was found, after three months' purifying, and which had formerly been mostly conducted over the roof."

ON RAILWAYS. BY JOHN HERAPATH, ESQ. NO. II.

Were I to pursue the course most agreeable to myself, and which might, perhaps, be expected of me, I should begin with a mathematical investigation of the theory of railroads; but as it will be far more useful first to review the merits of the several projected lines out of the capital, I shall take this course, reserving any points of science for the end, or using them as they may be wanted.

Of the Greenwich and Gravesend Railways.

One of the most remarkable railway-projections ever submitted to the public is perhaps that of the *Greenwich*. It is intended to be carried over a viaduct the whole distance from London to Greenwich, about 3¾ miles, on a series of between 900 and 1,000 lofty arches. These arches, too, are not to be the empty unprofitable supports only of the railway, nor the fruitful progenitors of disease by becoming the conductors of cutting currents of air, but are designed to be a range of elegant shops, with a shady enclosed footpath in the front, that is to the south, and a road for heavy goods in the rear.

How the smoke of these shops is to be carried off without offence to the trains above, I have not been able to perceive; but I presume this necessary provision cannot have been overlooked by the projectors. They can hardly permit so merciless an enemy to riot in uninterrupted annoyance.

No section, I believe, was ever published of this line, so that we cannot examine its working capabilities. The distance, however, is too short, and the country too level, to admit of difficulties of inclination. But when we consider, that with any thing of a load it will consume a mile or more to get up full speed, one cannot help smiling at a railroad only 3¾ miles long (in which the projectors state "there will be stations at proper intervals, along the line of road, to take up and set down passengers"), exhibiting that rapidity of transition peculiar to railways. Was the maximum velocity 35 miles per hour, I confess I cannot see how so short a line, with stoppages between the termini, can average more than 15 miles per hour. Such short intervals, too, between the stations must, I think, much increase the wear and tear of the machinery and rails, in consequence of the great strainings and exertions of the engines to get up their speed. Nevertheless, it seems by no means unlikely that this speculation may turn out convenient to the public, and profitable to the undertakers; while it will long continue an object of attraction to the east end of the town, and a monument of the bold ingenuity of its projectors.

Next to the Greenwich follows *the Greenwich and Gravesend Railway*, intended as a continuation of the former to Gravesend, that favourite resort of our London citizens. This scheme, it is said, has been laid on the shelf through the opposition of the Princess Sophia, Ranger of Greenwich Park, and the influence of Dr. Burney. We might here say that "the schoolmaster is abroad" with a vengeance, if, out of regard to Dr. Burney, or to preserve a few potatoe-ridges in his garden, his or his father's former pupils have been led to arrest a measure which was to contribute to the comfort and convenience of thousands, and from which thousands were to derive a subsistence. However, it is not my province to discuss the question of allowing or not our public parks and places of recreation to be cut and dissected for this measure or that measure. In one thing, perhaps, most will concur, namely, that places purchased with the public money, and set apart for the health, exercise, and pleasure of that valuable portion of our London population, the

trading and middling classes, should be held sacred from all invasion positively unnecessary, inconvenient, dangerous, or unsightly. This principle admitted, the question to be answered is, whether the Gravesend Railway be or be not unnecessary, inconvenient, dangerous, or unsightly; to which it would be but justice to add this other question—whether, supposing this railway had been concocted by either of the Government schemers, the public claims would have been at all regarded?

Looking to the line in a working point of view, it is among the best which has been proposed, and one cannot, hence, but feel regret it should be stopped. By the published section, which is not accurately marked, the line is very nearly level, being highest at the extremes, and declining gradually towards the middle; a very excellent form, within limits, for an easy and a good working line, but one which the country will rarely admit. The inclinations appear to be nearly 8 or 9 feet per mile; so that this line, which is likewise free from sharp curves, could probably be more safely and easily worked at 40, or even 50, miles an hour, than the Liverpool and Manchester could at 20 or 25. Indeed, 11-15ths of a maximum load for a level, might generally be worked on the Gravesend line; whereas, on the Manchester not more than 11-39ths can be worked without assisting engines.

Tunnelling has been avoided, and so have deep cuttings, except within about 4 miles of Gravesend. Here appear to be some of near 100 feet; but, as I have been informed the soil is chalk, it would amply repay expenses to transport it across the Thames to the cold soil of Essex for manure.

The line, too, is of very good length for the exercise of locomotive power. It is about 17¾ miles from Greenwich, and 21½ from London; a distance which I have no doubt, from the capabilities of the line, may be run in half an hour.

I have mentioned above that the heights of particular parts of this line are not marked, which precludes our going into nicer calculations of its speed, power, expense of working, &c. This is to be regretted, as the engineer, Col. Landmann, has apparently a line of which he need not be ashamed, and in which he has shown his confidence by publishing what does not often appear in prospectuses—a section of his ground. Indeed, it is not on his account that I repeat the complaint. It is for the purpose of calling public attention to the manner in which these matters—the chief by which the working merits of a railway may be tested—are kept out of sight. While every town, and almost every paltry hamlet, within miles of the intended line, are blazoned forth with auctioneer pomp, the vertical sections of the line and ground are studiously concealed. What can this be for? If a line be a good one, need a man fear its investigation; or rather would he not court it? "I would not," said a gentleman, to whom I once showed a difference of near 2,000,000 cubic yards between his Company's Parliamentary and prospectus sections—"I would not," said he, "put it in the power of such men as you in this way to pick a plan to pieces: I would publish no section." His hint was kept, and in a new project no section was given. This, probably, was prudent; but it is a fact which may impress on the public the necessity of caution, infinitely deeper than any arguments I could furnish.

No railroad project, in my opinion should be constructed until its merits shall have been publicly proved by some competent scientific man or men, in whom confidence can be placed. I say in whom confidence can be placed; for as in law, so it is in science, there are some with whom a good fee will always procure a good opinion, and even prove that the steeper and more difficult is the easier line to be worked.

Obloquy, I know, is frequently endeavoured to be thrown on scientific opinions by the ignorant and designing, from the vulgar prejudice, "that theory and practice are usually at variance." But I can assure my readers, that in no instance did I find experiments on the points I went last year to examine on the Liverpool and Manchester Railway at the request of one of the companies, differ sensibly from the results I had anticipated and computed previous to my going. Theory, indeed, as applied to any particular art, is no more than experiment generalised, and cannot, therefore, when managed with honesty and skill, materially differ from practice.

My best thanks are due to Mr. Julian for

his valuable letter, which did not reach me till the preceding had been written. His information I shall not fail to use; and I am gratified to find that this gentleman so perfectly agrees with me respecting tunnels, &c. Every one must coincide with the judicious observations his letter contains, which I shall hereafter with pleasure quote.

In my next I shall consider the southern lines.

JOHN HERAPATH.

Kensington, May, 1835.

THE METROPOLIS SPRING-WATER PROJECT.

We have just seen the Bill, now before Parliament, for incorporating "The Metropolis Pure Soft Spring-Water Company;" but we cannot say that the examination has at all diminished our objections to the scheme. The case stands thus: for several generations London has been supplied with water from sources on the surface of the ground, several Companies distributing it through works erected at an immense expense; during the same time many private persons and public establishments needing water of a different quality, or desirous of evading what they thought the exorbitant charges of the Companies, have obtained their supply from subterraneous sources by deep and expensive shafts and wells; in many cases the very existence of the concerns depends on the efficiency of their wells. Now the present water-companies are not much affected by the proposed plan, for they may buy the new water or not as they please; but the owners of wells have every reason to fear that *their* supply of water will be cut off altogether. Certainly common justice, as well as good policy, requires that something more should be known on the subject before this ruinous risk is imposed on them.

The preamble states truly, that "*great doubt* exists whether a sufficient quantity of water could be derived from that source (the deep springs) for the supply of the inhabitants of the metropolis and its environs." By what experiments do the Company propose to remove this doubt? By a gradual trial of the power of the springs, stopping when they find they can safely go no further? No; but by simply laying out at once all the capital necessary for the project in its full extent: for they are not to sell a gallon of water till they have proved, to the satisfaction of the metropolitan members, "that there is a sufficiency (for the supply of the metropolis and its environs) of such water as aforesaid;" which proof we humbly submit, knowing what we do of the metropolitan wells, can never be furnished till wells and machinery have actually used the necessary quantity, and that for many months together. And after all this risk (a risk undertaken, by-the-bye, in the face of facts, amounting nearly to a demonstration of failure), the dividends of the Company are still left contingent on the willingness of the other Companies to give up their own long-standing arrangements to buy this water. Verily, it looks almost as much like an "experiment" on the credulity of the public as on the power of the springs.

If, however, the Company have once incurred the immense expense of their experiment, it is not likely that the approval of the Commissioners will be long withheld. In a complicated affair like this mystification is easy enough, and pity for the shareholders would go far to reconcile any men to an inquiry, not over-nicely conducted. Besides, from the history of existing wells, it is very probable that should those of the Company supply at first the necessary quantity, that supply may fall afterwards far below the demand. Now in the case of mistaken approval, or of subsequent failure, how is each of the parties affected? The Company will possess machinery powerful enough to drain the whole metropolitan territory, and to make any dividend they must drain it to the lowest; private concerns and public institutions dependent on wells will be seriously embarrassed, or entirely destroyed; and the spring water which, through the public pumps and other means, is now at the command of the whole metropolis for those cases in which it is peculiarly needed, such as brewing, distilling, dyeing, &c., will then be drained away to be lavished indiscriminately for all sorts of purposes.

It should also be observed, that the Bill contains no clause authorising the

Company to sell to those who consume water in manufactories; while, in some cases, it may be so construed as to forbid their sinking new or enlarging old wells to supply themselves. Take the case of a brewer, whose supply is cut off by the immense pumping power of the Company: by the last clause (p. 4) of the Bill, the new Company can only sell to those Companies who sell again and distribute; and except the brewers, &c. &c., be included in that definition as selling water, though in a manufactured state, the new Company have no power to sell to them; but if they be so included, they are prohibited by pp. 5 and 7 from supplying themselves by any new or improved wells. They are thus left at the mercy of the intermediate Companies, to avoid which they have been at enormous expense, and would not be able to obtain spring water at all at a low temperature (for that, after all, is the grand consideration).

It is no trifling argument against the scheme, that in case of its partial success, it makes a monopoly of the only existing defence against present or possible misconduct on the part of the existing Companies. While a supply remains in the ground, which, though not adequate to the wants of the whole metropolis, is enough to withdraw on occasion a considerable number of the Company's customers, little need be feared; but when that source, too, is placed in the power of a body, which by the terms of its existence is bound to maintain a good understanding with the other Companies, the public will be left without refuge or power of remedy. This is no hypothetical case: many of the manufacturers of the metropolis have been, or thought they have been, under the necessity of defending themselves by this very measure, of which defence they could not have availed themselves had this Company been previously in existence.

To all these objections it will, perhaps, be replied, that the Bill subjects the Company to the control of the metropolitan Members of Parliament as a Board, and makes even its exclusive privilege dependent on them. We doubt much the political propriety of this part of the scheme, and certainly cannot expect either that the affairs of the Company will be administered without political partiality, or that the interest of the water-companies, for and against, will not be brought to play a prominent part in the election of Members—not much to the improvement of our legislative body. But this objection apart, what is it this Board of metropolitan representatives is empowered to do? Why, besides making regulations on subjects not at all affecting the present view of the case, it may, on proof of abuse of the privilege, or of its having become a *public* injury or inconvenience, declare the *exclusive privilege* forfeited. Now for four-fifths of the practical mischiefs of the plan this affords no remedy at all. For, first, it is doubtful whether the stopping of half the works in London, dependent on wells, could be deemed such a *public* injury as to justify the Board in cancelling the privilege; and, next, the Board has no power to revoke permission to work their wells—it can simply permit others to work wells too. What then does a brewer, a distiller, or a manufacturer gain, if, on finding his water fails, he complains of the Company, and succeeds to the utmost? He gets their privilege determined, but some other good neighbour finishes the little that remains of the business by sinking another well.

There is then but one supposition, that of an abundant undiminishing supply, on which the project of the Company will not do great and irremediable mischief; and the facts which have come to our knowledge respecting the existing private wells, have firmly convinced us that no such supply exists. The rapid lowering of all wells when severely pumped, the influence of distant wells on each other as they are drawn upon, and the gradual subsidence of the supply to all pumps, as the metropolis and its manufactures have extended, are among other facts utterly irreconcilable with the existence of the inexhaustible supply assumed as the basis of this scheme. But if it be not found, it is idle to suppose that the immense machinery of the Company, being once erected, will not be worked, let the consequence to others be what they may.

And to what *public* purpose is all this expense and hopeless risk? Is there any likelihood that if obtained the water

could be delivered to consumers pure as it comes from the earth, after exposure in reservoirs and traversing miles of pipes? And if not, what is gained between that supply and the present?

We are far from having exhausted the objections both against the scheme and the bill; but we think we have said enough to convince Parliament and the public that their sanction of the "Experiment" ought to be deferred till its projectors have devised some means of trying it less objectionable than those of spending, in the face of such risks, as much money as success alone could justify, and doing more mischief in spite of warning, than any probable success could remedy. And if gentlemen, though men of character, persist in promoting schemes whose fallacy may be proved by facts notorious or easily learned, and propose to execute them in modes which involve an immense outlay, and therefore a great profit to somebody before the confiding subscribers can be undeceived, they must not be surprised if they are suspected of being influenced by motives a little more selfish, than anxiety for either the profit of their supporters or the good of the public.

THE LAW OF PATENTS.

Sir,—The subject of the law of patents for inventions being brought again under the consideration of the public, by the introduction into the House of Lords, by Lord Brougham, of a bill for amending that law, I beg to send, for the consideration of your readers, the draft of a bill which I prepared some months ago; and I shall be glad of their opinions as to its utility as far as it goes. My object has been to allow the patentee to amend, but only after passing through such an ordeal as few would like to encounter. As to the expense of a patent—what should be the subject of a patent—and other points which have been raised in other bills, I know there exists such diversity of opinion about them, that they would certainly much endanger the carrying through of any proposed measure of which they should form part.

I am, Sir, your obedient servant,

ARCHIBALD ROSSER.

15, New Boswell-court, Lincoln's Inn,
June 9, 1835.

A Bill intituled an Act to secure the property of inventors in their inventions under letters patent.

Whereas it is expedient that the property of inventors in their inventions, for which letters patent have been, or shall be hereafter, granted, should be secured; be it enacted by the King's most excellent Majesty, by and with the advice and consent of the Lords spiritual and temporal, and Commons, in this present Parliament assembled, and by the authority of the same, that no such patent shall be void, although the subject thereof shall have been previously used, if the same shall have been used privately or in an imperfect manner only.

And whereas it sometimes happens that omissions or errors are accidentally, or unintentionally, made in the letters patent, or in the specification inrolled in conformity with the provisions thereof, in consequence of which such letters patent are held to be void or voidable; be it enacted, that no letters patent shall be at once wholly void or voidable either on account of want of novelty in the invention or of insufficiency in the description.

Provided always, and be it further enacted, that whenever upon the trial of any issue in, or directed by, either of the superior courts of record at Westminster, the validity or sufficiency of a patent or specification shall come in question, and the same shall be found to be invalid, or insufficient, in consequence of such patent, or specification, having been made, or left, or continued, erroneous, defective, or insufficient in description, the Jury trying such issue shall be directed to find, by their verdict, whether such patent or specification shall or shall not have been so made, or left, or continued, erroneous, defective, or insufficient in description, for the purpose of defrauding the public of the full benefit of the invention, or of deceiving any person; and if the undisturbed verdict of the Jury shall be in the affirmative, then and in such case the patent shall be null and void to all intents and purposes whatsoever: Provided always, nevertheless, that if the verdict of the Jury shall be in the negative, then and in such case it shall be lawful for the Lord High Chancellor or keeper of the great seal, upon petition made to him stating the several facts of the case, and the finding of the Jury, to direct such alteration in the patent and specification, or either of them, and in such manner and form, and at such time, and upon such terms and conditions, as he shall think fit.

And for the purpose of preventing fraudulent collusion between the parties to any such issue, be it further enacted, that no such alteration shall be directed, unless his Majesty's Attorney-General, or Solicitor-General, or

some barrister named by one of them, shall have been instructed by one, or both, or all, of such parties, and shall, at the expense of one, or both, or all, of such parties, have attended the trial of such issue on the part of his Majesty alone, and shall have certified his satisfaction with the finding of the Jury, and that in his opinion alteration may properly be directed.

And be it further enacted, that this Act shall come into force, and take effect, from and after the passing thereof; and that all the provisions therein contained shall apply to all letters patent then unexpired, as well as to all letters patent thereafter to be granted.

And be it further enacted, that this Act shall extend to Scotland and Ireland.

[Judging of Lord Brougham's bill from the speech with which his Lordship introduced it to the notice of the House of Lords, it is a very crude and ill-digested affair, not at all likely to be passed; and if it were passed, more likely to do harm than good. His Lordship is evidently but very imperfectly acquainted with the actual defects of the law which he has undertaken to amend: he does not know where the shoe pinches, though truth to speak, the *whereabouts* is no great secret. Neither can we say that our friend Mr. Rosser's proposed bill grapples with the evils of the existing system, in the way that the interests of the public and the interests of inventors alike demand; though so far as it goes it is certainly a much better bill than that of the learned lord. However, we shall be glad to be favoured with the opinions of any of our intelligent correspondents on the subject, and shall ourselves return to it as soon as we can obtain a copy of Lord Brougham's bill.—Ed. M. M.]

MOTION OF FLUIDS.

Sir,—I am by no means offended, although certainly somewhat surprised, at the comments of J. L. in your last number, upon my description of a singular hydraulic phenomenon. The writer's arguments appear even more singular than the phenomenon to which they refer. J. L. says, p. 92, " it is an established fact, that the jet of water issuing through simple orifices is *contracted*, in a certain degree, in proportion to the extent of that orifice;" but I beg to observe, that I have been for the last fifteen years in the constant habit of observing jets issuing from apertures of various sizes, urged by different forces, but I never met with any one instance of perceptible contraction, until the experiment with the flat-topped cylindrical branch-pipe, as described at p. 6. In this statement I am also corroborated by many persons, whose experience in these matters has been far more extensive than my own.

At the same time that this branch-pipe was tried, and the remarkable contraction witnessed, a tapering branch-pipe of the usual form was also used with a seven-eighths nose-pipe, and (unfortunately for J. L.'s hypothesis) no contraction ensued; the stream of water delivered, being full seven-eighths of an inch in diameter.

To the question of J. L., whether the branch-pipe was held vertically, I reply, certainly not; or the holder, as well as the observers, would have been deluged with water. The branch was held in different positions, at angles of from 20° to 40° from the perpendicular; but change of position did not seem to influence the result. I am not quite sure what J. L. means by the force of *gravity*, because it is difficult to separate this idea from the force of a column of water of some determinate height; certain it is, that *gravity* alone will not produce any contraction of the stream, even in the form of vessel described at p. 6. The working of the engine had proceeded far beyond the point of pressure that gravity alone could produce, before the *contraction* took place; in fact, it was only under *great pressure* that the phenomenon obtained.

It appears to me, that J. L. has been misled, by M. Bossut's "Tables of the Ratios of the *theoretical* to the *real* discharges of fluids from circular tubes one inch in diameter, under the pressure of columns, varying from one to fifteen feet high," inserted in the Engineer's pocket-book for the present year.

The theoretical to the real discharge, under the pressure of a one-foot column, is said to be as 1 to 0.62133; and under the pressure of a fifteen-feet column, as 1 to 0.61716.

This difference is no where attributed to any *contraction*, which is a gratuitous interpretation of J. L.'s. The difference between the estimated and actual discharge, arises from the varied velocities of different portions of the fluid; the particles of water in contact with the sides of the containing vessel are retarded by friction, and move more slowly than the particles in the centre of the stream, which move with the greatest velocity—perhaps with that which is theoretically due to them.

Great, as doubtless is the utility of M. Bossut's tables in all circumstances coinciding with the experiments from which

they were obtained, still they are by no means applicable to jets issuing with great velocity.

M. Bossut himself states that the results vary much with slightly altered circumstances; but it is evident they must assume an entirely new character, under a force equal to the production of a jet sixty or seventy feet high—a pressure at least ten times greater than any he investigated.

I am perfectly convinced that a contraction equal to that which was witnessed in the experiment described at p. 6, was never observed, certainly never recorded before; and it is pretty generally admitted, that this fact is one of the most singular and extraordinary phenomena in the motion of fluids with which we are at present acquainted. I could explain much farther, but I think I have said enough to convince J. L. that he has taken quite an erroneous view of the matter.

I remain, yours respectfully,

W. Baddeley.

London, May 12, 1835.]

SUGGESTION OF A NEW SOURCE OF MOTIVE POWER ON BOARD SHIPS.

Sir,—I have frequently, during calms at sea, observed the rudder of the ships raised as her stern sinks, and fall again as her stern rises, resembling the motion of a piston in a steam-engine. Now, might not this motive power be turned to some useful account?

I am aware of Lord Dundonald's proposal, in No. 583 of your Magazine; but that involves the employment of immense masses of quicksilver. My idea is, that the motion of a ship's rudder, weighing perhaps five or six tons, rising and falling on its hinges, as it does in the swell of the sea, might be applied to propelling purposes; or rather that machinery might be constructed to take advantage of that rising and falling, for the rudder itself could not well be applied to such a purpose.

At the same time, I merely throw out the idea with the view that ingenious men may consider of it.

I am, Sir,
Your obedient servant,
John Norton.

U. S. Club, April 28, 1835.

MUSCULAR FORCE.

Sir,—The case in archery which I stated in your interesting Magazine, p. 306, No. 555, was given in the hope that it would excite some discussion, likely to correct erroneous ideas on the subject of muscular power, and the force of springs. My own views of the case had been previously given, in an early Number of the "Gentleman's Magazine," for the present year, and therefore I did not require the kind of answer furnished by your correspondent, J. W. (p. 434). According to him, a person holding the fifty-pound bow in his left hand, and drawing the string with his right, exerts a force of a hundred pounds. If so, let me ask him what force each person exerts, when one holds the bow and another draws the string? Again, let a straight stick be provided, capable of supporting, when placed vertically on "a deal table," or on the floor, fifty-one pounds, and of such a length as to be put end-wise between the bow and string when drawn; in this case, will it not, without giving way, maintain the bow so bent?

I am Sir,

A Well-wisher to your publication,

A. M.

NOTICE OF THE HOT-AIR SYSTEM OF SMELTING IN GREAT BRITAIN. BY M. DUFRESNOY.

(Abridgment continued from p. 104.)

Derby Iron-Works.—The coal basin of Derby, a prolongation of that of Sheffield, contains many large iron-works; three of them, the Butterly, Codnor Park, and Alpdon works, have adopted the hot-air blast. I visited the first two, under the charge of Mr. Jessop, one of the most intelligent ironmasters in the kingdom. The heating apparatus of all these differ from those I have described, and, in some essential respects, from each other. For this reason I have deemed it proper to describe them in detail, though the results which they give are not so favourable as those obtained at the Calder works.

Butterly Iron-Works contain three smelting furnaces. The iron there made is intended for castings, either of first or second runnings. One furnace only was in blast when I visited Derbyshire. The air for the blast was heated by an apparatus at each tuyere, com-

posed of large pipes, 27 inches diameter in the clear, placed horizontally one over the other, and separated by arched plates. These pipes are connected in pairs, by elbow pipes. The air from the blast-engine enters by the pipe, passes the length of the three pipes successively, before passing into the atmosphere. The joints are placed on the outside of the furnace proper; but to prevent the air from being cooled in traversing the elbows, they are cased in brick-work.

The elbows connecting the long pipes are in plates, connected by bolts and nuts, passing through lugs or flanges. The pipes are $1\frac{1}{2}$ inches thick, and rest upon fire-lumps, placed at proper distances upon the arch plates. This disposition allows the flame to envelope them on all sides.

The first pipe is not exposed directly to the action of the fire; it is separated from the grate by an arch of brick, extending the whole length of the furnace, which allows the flame to pass by the flues. The partitions have openings placed at the opposite ends of the furnace, so as to compel the flame to traverse the whole length, without escaping from one story to another. All the arches are of fire-brick, one brick thick. The expenditure of this apparatus is 62 cwt. for each ton of casting made. The air is raised to 360° Fahr. Notwithstanding the feeble temperature, a great economy of fuel is effected, as indicated below.

Consumption and Products during the first week in July, 1830, from furnace No. 2, worked with Cold Air.

159 tons 5 cwt. of coke, corresponding to			
	218 tons	10 cwt.	of coal,
	109	17	of ore,
	35	0	of flux,

Produced 83 tons of metal.

Consumption and Products of furnace No. 2, on the 17th of July, 1833, heated air being used.

The furnace received 41 charges, each composed of

9 cwt. crude coal,
9 ore roasted,
3 flux.

The average of the first fortnight in July had been forty charges per day, and the iron produced seven tons.

Upon comparing, from these data, the consumption of the two periods, one ton of iron required as follows:

1830.

Cold Air and Coke.

Coal	5 tons	16 cwt.
Ore	3	..
Flux	1	..

1833.

Heated Air and Coal.

Coal..	2 tons	18 cwt., including fuel to heat the air.
Ore ..	2	11
Flux..	1	..

To know the whole expense of fuel, that used by the blast engine must be added, for which I have no precise data; but this expense must necessarily diminish in proportion to the increased yield of the furnace.

At Butterly, therefore, a saving of one-half the fuel has been effected by the introduction of the new plan. The quantity of flux remains the same, because the sulphurous nature of the coal requires a large proportion of lime.

The blast-engine, which served but two furnaces, now works three; but to obtain this increase, a larger cylinder was put in. Formerly, the cylinder was 70 inches in diameter, and 8 feet stroke, working 13 revolutions; now, the cylinder is 80 inches, the length of stroke, and number of revolutions, remaining the same.

The quantity of air expended, which was 2,500 cubic feet per minute, is now reduced to 2,160 feet; but the pressure, $2\frac{1}{4}$ lbs. to the inch, has undergone no variation. The opening at the mouth of the tuyere has been reduced from $2\frac{1}{4}$ to 3 inches; the iron produced is intended for castings.

Codnor Park Works.—This work consists of three furnaces, three refineries, and a sufficient number of puddling furnaces to work up all the metal. These furnaces have worked for the past year with heated air and crude coal. The substitution of heated air has produced a saving of fuel similar to that stated for Butterly; 2 tons 9 cwt. being now sufficient to obtain 1 ton of metal, which formerly required 5 tons. It should be remarked, that the expense of coal has always been less at Codnor Park than at Butterly, on account of the difference in the quality of iron produced. This difference would be much more sensible, if the same quality of coal was used at both works; but at Codnor Park the soft coal is used, while at the other a variety called cherry-coal is used, which better resists the action of the blast.

Consumption for one ton, using Cold Blast.

Butterly	5 tons	16 cwt.
Codnor Park	5	..

Same, with Hot Air.

	Butterly.		Codnor Park.	
For smelting..	2 tons	12 cwt.	2 tons	9 cwt.
apparatus	0	6	0	6
Total....	2	18	2	15

The apparatus employed at Codnor Park, for heating the blast, is composed of two pipes, placed one above the other, in which are inserted small pipes, having the same centres as the large pipes. These pipes are connected by elbows, so that the air, in passing from the blast-engine through the interior pipe, spreads itself over the circular space between the pipes; passing then into the second interior pipe, is transmitted to the furnace by traversing the second circular space.

This disposition of double pipes, one within the other, was adopted to remedy a serious inconvenience experienced at Butterly, an inconvenience incident to pipes of large diameter, in which the air being heated unequally, a current of cool air passes along the centre of the pipe, and renders it impossible to raise the temperature sufficiently.

The large pipes are of cast-iron, 30 inches diameter outside, and $1\frac{1}{2}$ in. thick; the small pipes are of boiler iron, $\frac{6}{10}$ths of an inch thick, and 18 inches diameter in the clear. The construction of the furnace is the same as at Butterly. The air is heated by means of this apparatus to 400° Fahr., with a consumption of 6 cwt. coal.

We have already stated that all the metal made at Codnor Park is made into malleable iron:* this iron is used in the machine shops of Mr. Jessop. It serves equally well for boiler iron for steam-engines, a use which requires the very best metal.

Environs of Birmingham.

The introduction of the hot-air blast has scarcely commenced in the Staffordshire iron district, the opinion being still prevalent that the quality of the iron is deteriorated by its use, has retarded the trial of it until within a year past. One work only, near Wednesbury, belonging to Messrs. Lloyd, Forster, and Co., uses the heated air. The success attending this experiment determined the proprietors of the other works to make similar trials.

The apparatus employed here is placed above the trunnel head of the furnace, and is the only one at which such an arrangement has been effected in England. It is composed of a solid pyramidal ring, and a series of small tubes, which penetrate into the furnace.

The interior surface of the ring is a cast-iron cylinder, 4 feet in diameter, and 12 feet in height, in place of the chimney which usually surmounts the trunnel head of the furnace. The exterior surface of the pyramid is octagonal, and made of boiler plates, riveted together, like a steam-boiler, its diameter at the middle being 6 feet; a space is left between the surfaces of 1 foot on all sides; to protect the outer surface from the cooling action of the air, it is encased in brick-work.

The air passing from the blast-engine is carried to the top of the furnace, circulates through a circular pipe, on a level with the top of the furnace, then divides itself among eight vertical pipes, placed round the outer surface of the casing, which are connected with the circular pipe; each of these vertical tubes communicates with the interior of the case, or pyramid, by six small tubes, which pass into projections within the interior of the furnace.

The air, after being heated in the tubes, and in the circular heater, re-ascends to the tuyeres. To prevent the air from cooling during the transit, the conductor is placed in the chimney of the steam-boiler, 12 or 15 feet distant; a kind of brick work connects the furnace with this chimney.

With all these precautions, the temperature of the blast cannot be raised higher than to 360° Fahr., and they are obliged to heat it again in a furnace, within a few feet of the embrasure of the furnace.

The consumption of this fire is nearly 4 cwt. of coal to the ton of iron.

This apparatus is very costly, and requires frequent repairs; the little saving of fuel effected by it (about 3 cwt. of coal per ton of iron), is more than compensated for by the expense of construction and repairs, and, above all, by the numerous interruptions which take place in consequence of repairs required almost daily.

The introduction of hot air has effected, in these works, the same economy as in the others cited, where this plan is adopted. One ton of iron required, in 1831, 3 tons of coke, equal to 5 tons 9 cwt. of coal; now, the same quantity of iron consumes 2 tons 14 cwt. of coal, as the following statement shows.

On the 20th of July, there passed through the furnace twenty charges, composed of—

10 cwt. crude coal,
9 roasted ore,
6 flux.

The product being 8 tons of metal, each ton consumed—

	Tons.	Cwt.	Tons.	Cwt.
Coal for fusion	2	10		
for heating the apparatus ..	0	4		
			2	14
Ore roasted			2	5
Flux			1	10

The consumption in flux was considerable, because of the sulphurous nature of the ore. The slag which came from the furnace was crystalline, and gave off very strong sulphur-

* This is an error, as large quantities of pipes are cast at this work for the London Market.—*Trans.*

ous odours. Before the introduction of hot air, the daily production of the furnace was only 6 tons. They have, therefore, obtained, besides an economy in fuel, a diminution of the general expenses, and of labour. The quantity of blast has not been changed, but the tuyeres have been enlarged from 2 inches 9 lines, to 3 inches 6 lines.

Part of the iron produced at the works of Mr. Foster is used for the foundry, and part for fine metal; the same running gives both kinds of iron; that which flows first from the hearth is No. 1, pig metal; the last running gives No. 2. They distinguish the two kinds of iron by the manner in which they run from the furnace, and by the furrows produced on the surface when it cools.

Wales.

There are in Wales but two works using the heated air—that of *Warteg* and *Blaen-Avon*, ten miles from *Abergaveny*. None of the *Merthyr-Tydvil* works have introduced it, though the *Dowlais* and *Pen-y-danau* have made experiments thereon.

The abandonment of heated air in so extensive an iron country, and in which improvements are sought after with care, has led many to doubt the reality of the advantages claimed for it. Some have thought that, while so much saving was effected by this plan in the furnaces of Scotland, where the metal was destined for the foundry, it could not be employed by other works, the product of which is converted into bar or malleable iron.

The examples furnished by the *Newcastle*, *Codnor Park*, and *Wednesbury* Works, in which they make bar-iron of very good quality, prove that this opinion is not well founded. The partial abandonment of the plan in Wales, should, in part, be attributed to the bad construction of their heating apparatus, but more especially to the diminished saving which would result to them, since the employment of crude coal has been effected; a saving which the cost of the patent would almost balance. To appreciate these reasons, it is necessary to enter into some details upon the expense of making iron in that country. From all the information gained upon the experiments made at Dowlais, or Pen-y-danau, it appears that, the apparatus being of bad construction, the temperature of the air could not be raised to more than 300° Fahr. Notwithstanding this, they attempted, with success, the substitution of crude coal for coke. An accident happening to the apparatus, obliged them to suspend the use of hot air for several days, and showed them that, without difficulty, the crude coal could be worked even with cold air. The saving which resulted from this substitution was such, that the proprietors did not deem it worth while to repair the heating apparatus, and thenceforth abandoned it. Since that period, most of the Welsh furnaces use the crude coal, but some employ a mixture of coal and coke.

The following table shows the quantity of fuel and metal required to produce one ton of metal:—

	Pen-y-danau.			Dowlais.			Cyfartha.			Plymouth.		
	t.	c.	q.	t.	c.	q	t.	c.	q.	t.	c.	q.
Coal	2	9	0	2	14	0	2	13	2	2	13	0
Ore roasted	2	4	0	2	9	0	2	6	2	1	16	0
Ashes	0	2	2	......			......			——		
Flux	0	19	2	0	13	0	0	16	0	——		

Add to this, the quantity consumed by the blast-engines, about the same for each, varying from 5 to 6 cwt.

The average quantity of coal consumed in each of these works, is, therefore, 2½ tons for each ton of iron. By the employment of heated air, it is not probable that a saving would be effected over this expense of more than 33⅓ per cent., or 17 cwt. of coal for each ton of iron; deduct from this, the fuel consumed to heat the apparatus, estimated at 6 cwt., and the actual saving would be reduced to 11 cwt., costing at 3*s*. 7*d*. or 86 cents per ton, at the works, 44 cents; and as the patent right is charged at one-half, or 24 cents per ton of iron, the saving would be diminished to 20 cents per ton. This economy, itself very small, would scarcely be appreciated in a district where all the materials are so cheap, that iron may be produced at a less price than in any other district in Great Britain.

I believe, therefore, that the non-adoption of this plan in Wales, is no evidence that, it does not effect any saving in fuel; but, on the contrary, it leads me to think that there would be economy, as in other works where the plan is used; but it is evident that, the expense* of coal being very small in Wales, the economy would not be as marked as in the works of Scotland.

The *Warteg Iron-Works*, which have been named at the beginning of this section, sustain this opinion. In this establishment the heating apparatus is composed of a very short development of pipes, so that the air cannot acquire a temperature of more than 400° Fahr. The coal, which is very bituminous, and loses 50 per 100 in the coking, cannot be employed crude in the furnace, with the air at so low a temperature; it results from

* The author should have attributed this difference, in a great degree, to the superior quality of the Taff Vale coal over the Scotch, the former yileding more than 75 per cent. of carbon, while the proportion in the latter is less than 65 per cent.; some varieties even as little as 51 per cent.—*Trans.*

these circumstances, that the saving is not so great as at the furnaces of Scotland, but it is to be compared to the saving in those works where the apparatus is not so perfect, and where coke is still used. Nevertheless, the diminution in the cost is very marked; before the introduction of heated air, one ton of iron required a consumption of two tons of coke; the produce of 4 tons 3 cwt. of coal. The consumption of coke is still about the same, but, as there is no necessity for carbonising it so completely, it is now produced by only 3 tons of coal.

The yield of the furnace has been augmented from 6 to 8 tons of iron each in 24 hours.

(To be continued.)

NOTES AND NOTICES.

Mr. Nash.—This celebrated architect died on Wednesday last, at his seat, East Cowes Castle, Isle of Wight, in his 83d year. In private life Mr. Nash was a warm-hearted and generous man; of his professional rank and talent, it is more difficult to speak soberly and justly. He was, as is well known, especially patronised by his late Majesty, who had a somewhat strange and fantastic taste in architecture, and was certainly not a man to be dictated to or controlled. After all, these are matters of comparative unimportance, when it is remembered, that to one or the other, probably to the one for suggesting and authorising, and to the other for elaborating out and carrying into effect, we are indebted for the magnificent improvements which have of late years taken place in London—improvements which contribute equally to the beauty and health of the town—to the luxury of the rich and the comfort and enjoyment of the poor. —*Athenæum.*

Canal between the Atlantic and Pacific.—Baron Thiery, of Panama, has addressed a memoir to the President of the Republic of New Grenada, on the subject of connecting the Atlantic with the Pacific. The Baron prefers a canal to the contemplated railroad, and pledges himself to complete one within two years.—*American Railroad Journal.*

The India-rubber Boat.—The boat was invented, says the *Providence Journal*, by Mr. Caleb Williams, jun., of this city, and was manufactured at the India-rubber factory on Eddy's Point. It is constructed very much on the plan of Burden's steam-boat, with two inflated cylinders of India-rubber cloth, connected upon the top by five or six beams of light portable plank, which supports a deck of boards, which may be procured at almost any place where the boat is to be used. The whole apparatus weighs about twenty pounds. The cylinders may be both inflated in from five to ten minutes, and when the air is discharged, may be folded in a valisse. The rest of the apparatus may be conveniently carried in the bottom of a waggon or chaise. In addition to the whole is a seat, on which the angler may sit, and hold his dominion over the finny race. This boat will sustain at least one ton weight, and by enlarging the deck would accommodate quite a party. The elasticity of the cylinders has been proved to be a protection against their being punctured by snags and rocks.

Teams v. Steam.—"Quite an animated contest has been carried on for several weeks past," says the *Frederick Md. Herald,* "between those enterprising mail-coach proprietors, Stockton and Stokes, and the Baltimore and Ohio Railroad Company, in the transportation of passengers between this city and Baltimore, which has caused considerable excitement among our citizens, who watch the arrival of cars and stages with much interest. On one day the stage will arrive, full of passengers, at a slapping pace, full 30 minutes before the cars—the next they come out neck and neck, or rather neck and boiler—on the third the steamer is ahead, and dashes on to the depot like a thunder-cloud, with a streak of lightning attached to it—or a dog with a tin-pot to his tail. 'Hurrah, Stokes!' 'Hurrah Steam!' are now screamed out from many a throat, with as much fervour as ever was the battle-cry of Richard Cœur de Lion. How long this steam and team contest will last, we cannot say—for one of the parties seems to delight in hot water, and the other is determined not to break down whilst a wheel is left between this and Wheeling. But little we reck if it continues as long as the Trojan war, for it is rife with benefits to the editors on the route, and enables us to receive the eastern mail some hours sooner than formerly. The opposition of Messrs. Stockton and Stokes was caused by an extravagant demand by the railroad company for carrying the mail between Frederick and Baltimore."

English and French Ship-building.—"Those writers who contend for the superiority of the French in the art of ship-building, on the ground of the superior sailing qualities of their ships of war, have not gone sufficiently into the philosophy of the thing—not paid attention enough to the opposite national characteristics involved in the question. With the English seaman the great object has always been to come to close quarters—with the French to *get away.* Clerk, in his Naval Tactics, places this fact beyond all question, by a critical review of a whole century of rencontres between English and French ships of war. The shipwrights of the two nations took each their cue—very naturally—from their respective employers; one built for fighting, the other for flying: and so it has happened—as surely as supply is always according to demand—that no ships sail so well as the French, and none fight better than the English."—*Anglicus.*

The small sketch which accompanied Mr. Gilbert's communication has unfortunately been mislaid. Could he oblige us with another?

Communications received from A Friend to Railways—Mr. W——n—W. H.—Mr. Jos. Gibbs—M. N.—T. D. E.—A Subscriber residing in Paris—Vigilans.

The Supplement to our last Volume, containing Titles, Index, &c., with a Portrait, on Steel, of Samuel Clegg, Esq., C. E., is now published, Price 6*d*.; also the Volume complete, in boards, Price 8*s*. 6*d*.

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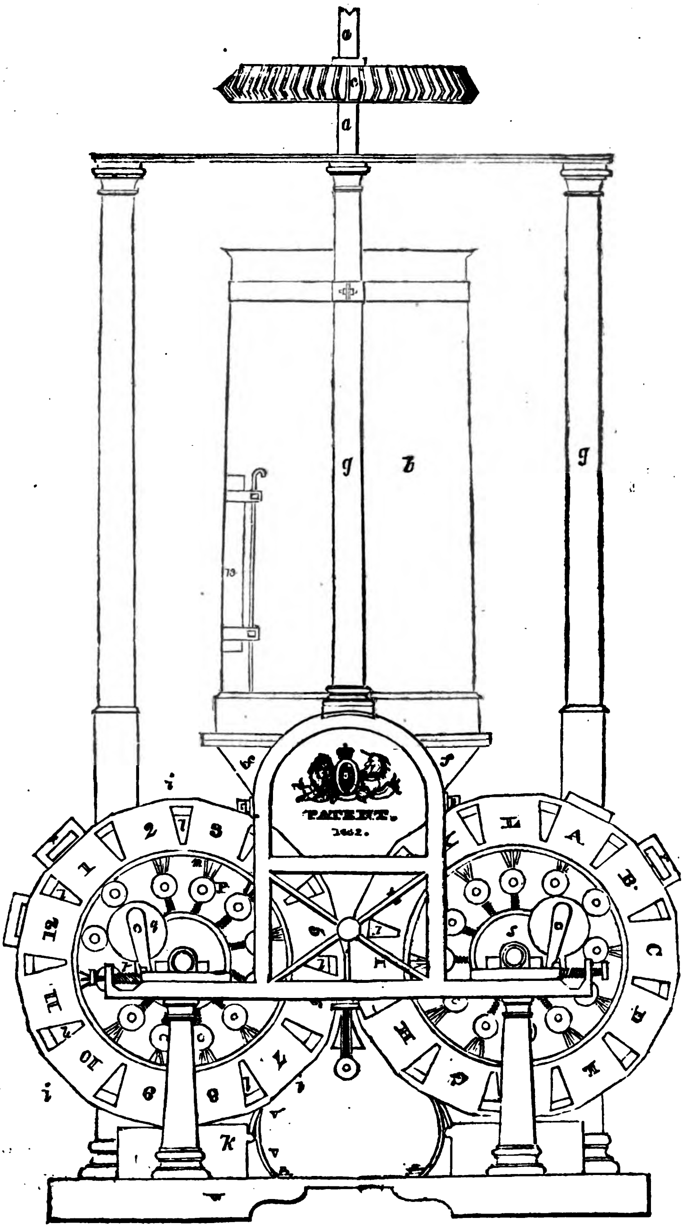
CLARK, NASH, AND LONGBOTTOM'S BRICK, ACID-DROP, AND LOZENGE MACHINE.

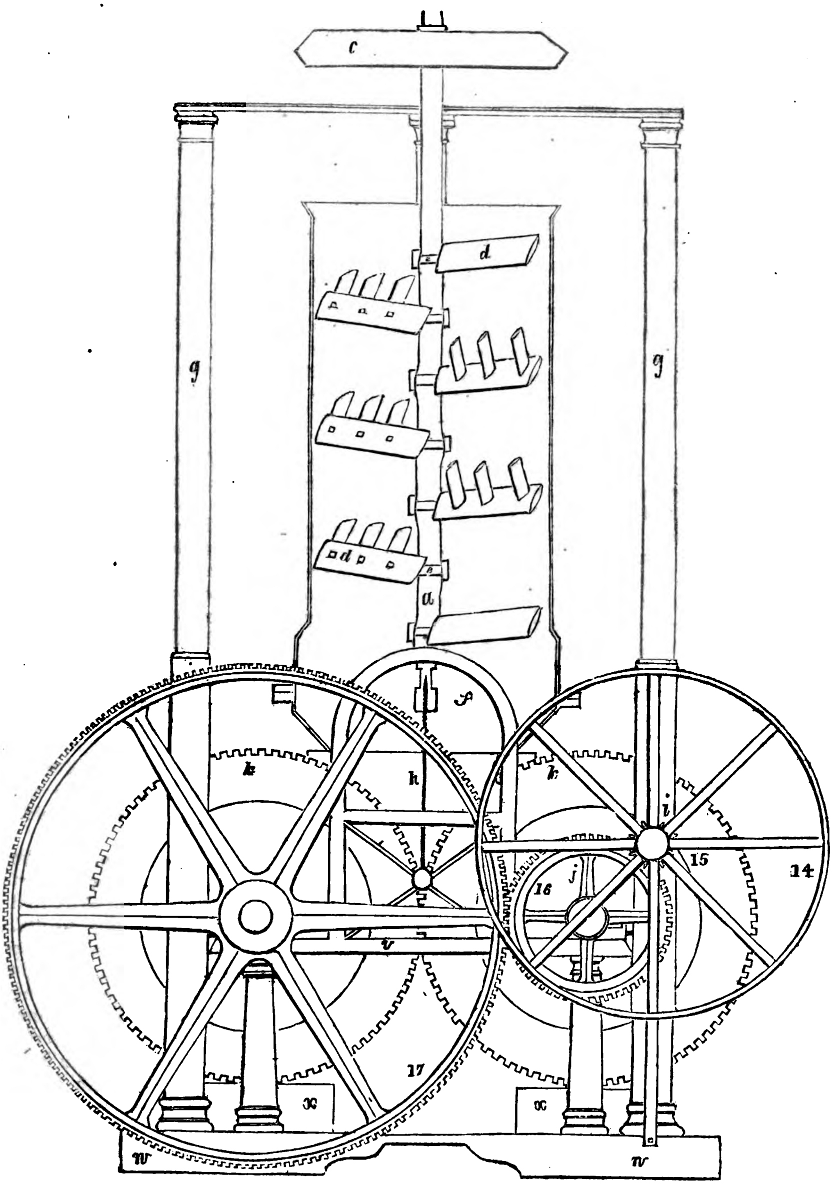
Fig. 1.



MESSRS. CLARK, NASH, AND LONGBOTTOM'S PATENT MACHINE FOR MAKING BRICKS, ACID-DROPS, LOZENGES, &c.

The accompanying engravings represent a very ingenious machine, which has been patented by Messrs. Clark, Nash, and Longbottom, of Leeds and Market Raisin, for manufacturing bricks, tiles, acid-drops, lozenges, &c. It obviates effectually the principal difficulties which have hitherto attended the application of machinery to the manufacture of plastic materials, and is, we understand, coming into very general use. Fig. 1 represents a front view of the machine, and fig. 2 a back view. It is 9 feet high, and 5 feet by 4 wide. A vertical shaft *a a*, is made to revolve in the cylinder, or pug-mill *b*, by the application of an adequate force from any first mover, which may be effected through the medium of gear applied to the bevel-wheel *c*, or by the employment of any other suitable mechanical agency. To this shaft are fixed broad steel or iron knives, or blades *d d d*; circular holes are made in the shaft, through which the rounded extremities of the large blades are passed, and secured on the opposite side by screwed nuts *e e e*, in such a manner as to allow of the position of the blades being easily adjusted, or inclined to the angle best suited to the preparation and passage through the cylinder or pug-mill, of a given quantity of clay or other plastic material, in a given time. When the mill is charged, the motion of the knives or blades, produced by the revolution of the vertical shaft, gradually tempers the plastic material, and forces it into the hopper *f*, fixed to the lower extremity of the pug-mill. This hopper is divided into two equal chambers by a vertical blade or knife, which separates the clay, or other material; so that equal quantities are supplied to the moulds, and in a much stiffer and more homogeneous state than is practicable by the application of manual labour. The moulds employed are separate, that is, they may be detached at pleasure from the cavities in which they are lodged. Recesses for the reception of these moulds are formed around the peripheries of two pairs of wheels, with broad brims *i i i* (one pair of which is plain, and is brought into view in the front figure; the other pair is toothed, as seen at *k k k* in the back figure), and being in gear with each other, are made to revolve in opposite directions, by a motion communicated to one of them. At equal and proper distances are fixed two distinct wedge-formed boxes, denominated hollow sectors, marked *l l l*. When so arranged, the form of the sectors causes a similar number of rectangular spaces to be left alternately between them, as denoted from A to L in the right-hand wheel, front view, and in the left-hand wheel, same view, by the figures 1 to 12. Into these the separate or detached moulds are put during the operation of the machine. The form and dimensions of the moulds are varied, according to the nature of the articles to be produced therefrom, and the moulds themselves (after being filled with plastic material) are pushed out from their recesses by means of pistons at *m m* easily fitting the recesses, and sliding upon parallel rods fixed to the rims of each wheel. To the bottom of each piston, and connected with the parallel rods, is attached a flat shaft, which carries a small anti-friction wheel P, which, by the motion given to the machinery, on approaching the place of delivery, comes in contact with a larger wheel *q* placed eccentrically, from the wheels of the mould receivers, and raises the moulds *r r*, containing the tiles, bricks, or other moulded articles, within them, which are then to be taken off and removed by the hand. During the latter process the emptied mould receivers will have passed over the centre of the eccentrically placed wheel, and the piston will have descended, or be descending, when the person in attendance replaces the emptied mould to its former situation, to be filled again from the hopper as it passes under it. The rims of the wheels for the mould receivers are made polygonal, or flat-sided, at the edges, between the hollow sectors and the axis *s s*. These wheels revolve in plumber-boxes, mounted on pedestals or blocks, which slide horizontally between guiding grooves, made in a strong metallic framing or rails underneath. To one end of each pedestal is attached a helical spring *t t*; the other end of each spring abutting against a regulating screw, which passes through the extremity of the fixed rail; the result of which is that the pedestals and

Fig. 2.



the wheels which they carry are kept constantly in contact, notwithstanding the unequal polygonal figure of their rims. In the middle of and underneath the horizontal rail, is fixed a knife *u*, supported in its place by the elastic pressure of a spiral spring, which separates the whole, or a portion, of the superfluous materials from the moulds, as the latter pass over the edge of the former. As some redundancy of material may still be left after the second operation of the knife *u*, the exposed surface of the moulds in motion undergoes a similar treatment from two other knives *v v*, fixed to the foundation-plate *w w* of the machine. A trough, or cistern *k k*, containing water or other suitable fluid, is placed underneath each of the wheels, which, at their lowest point of revolution, come in contact with a cylinder covered with strong coarse cloth, or some other absorbent substance, which, as it revolves, takes up the fluid from underneath, and delivers it to the moulds. These cylinders are mounted on elastic bearings, and derive their motion from pinions on their axes, actuated by the toothed wheels of the mould receivers. In the centre of the foundation-plate there is a cavity or pit, for the reception of the superfluous clay, or other material, whence it is removed at pleasure. In the cylinder or pug-mill is a door (13), for the convenience of cleaning it out when required. The whole of the upper part of the machine is supported by columns, *g g g*, fixed to the foundation plate. The mould receivers are driven by means of a pulley or strap wheel (see back figure), fixed to one of the columns, to which pulley-wheel is attached a pinion (15) that drives a larger wheel (16) running loose on the shaft of one of the mould receivers: this last propels another large wheel (17), fixed on the shaft of the other mould receiver; gearing into each other, they are driven round together, but in opposite directions.

A brick machine of this description, when used with a one-horse power, will produce 700 bricks per hour, with the help of two men and eight boys, making the entire cost something less than 2*s.* 6*d.* per thousand. If a two-horse power be employed, the production will be about 16,000 per day. The meanest description of brick costs, when made by hand, 4*s.* 6*d.* per thousand. All the bricks produced by the machine are, from the manner of grinding the clay, and from its subsequent extraordinary compression in the moulds, equal in appearance, and much superior in quality, to the very expensive polished bricks used for the fronts of houses.

The most essential and material feature of this invention was, we understand, communicated, in the first instance, by Mr. J. Longbottom, to the other two patentees, namely, the means of remedying the adhesion or stickage of the plastic material to the moulds, cylinders, &c. "Emboldened by this exciting fact," says our informant, "the three patentees were led to embark in the undertaking, and have severally contributed their labour and unceasing efforts for a lengthened period, successfully, to the production of perfect brick, acid-drop, and lozenge machines. Amongst the numerous patents taken out for making bricks by machinery, and after an enormous cost in experiments, there was one granted to Harrison and another, chemists, at Dublin; and it is recorded that, although the cause of stickage was fully comprehended by the parties, yet their remedies to remove it were ineffectual. One of Messrs. Clark's and Co.'s brick-machines was lately purchased and shipped for Poland. Acid-drop machines are also already in use at York, Leeds, Selby, and London."

Since the preceding notice was written, we have received a letter from the patentees themselves, an extract of which we subjoin :—

"A brick machine, on our plan, to be worked by hand labour, was completed on the 21st May last. It is portable, and easily moved; its cost from 30*l.* to 40*l.* The clay, as you are aware, is worked up in a much stiffer state than it could be in the ordinary way. The cost of making bricks is not more than by the common method, and instead of a mean description of brick being produced, you have solid compact bricks, pressed with extraordinary mechanical force, which are equal in appearance, and much superior, to the best polished bricks. One of the machines is always open to inspection at the manufactory, Edward-street, Lady-

lane, Leeds. In reference to the acid-drop machines, it may be worth mentioning, that although it was stipulated with some of the purchasers, that they should show the machine when at work, and give information to applicants, yet not one of those parties have fulfilled the conditions, desiring, apparently, to appropriate to themselves the benefits of the invention, which are, however, too important to be long kept from the public generally. Mr. Terry, York, makes half a ton of acid drops per day with his machine."

ON RAILWAYS. BY JOHN HERAPATH, ESQ. NO. III.

"If a man," observed a gentleman, "gets up in an assembly, and proposes some good plan, the applause he receives generally stimulates others to add amendment to amendment, each commonly more absurd than the preceding, until the good sense of the original motion is absolutely lost in the mass of succeeding absurdity." Similar it has been with railways. One successful railway has produced designs for dozens and dozens of others, the majority of which are too preposterous to end in any thing but disappointment and loss. Amidst numerous plans for the earth, some have actually invaded the air with designs for suspension railways; others, I am informed, have talked of subduing the oscillations of the sea by a railway of boats; whilst a third party have gravely contemplated making a railway first, and creating a terminus town, and of course traffic for it afterwards. Surely we have but one step more to reach the climax of folly—a project to tunnel the ocean, or to make a railway to the moon.

That it is needful to stop "the torrent of wasteful delusions," in many of the present schemes, I perfectly agree with Mr. Julian; but I know no method by which it can be done, unless by laying before the public the means of judging of the merits of the several schemes in the easiest possible way. With this view I shall, in the present letter, consider the principles of comparative power, expense, and velocity of railway transit, and postpone my observations on the southern lines to another letter.

Principles of Railway Transit, as they regard the Force of Traction, Expense, and Speed.

Force of Traction.

If t denote the force of traction of a ton on a level, and z the angle of inclination of any plane,

$$t \cos z \pm \sin z,$$

is obviously the force of traction in ascending or descending the plane, the plus sign being used for ascending and the minus for descending. And because in all practicable railways z is very small, and t by experiment about $\frac{1}{240}$, the force of traction is as

$$1 \pm \frac{h}{22} \text{ very nearly} \ldots (1)$$

in which unity is the force of traction on a level, and h the height in feet per mile of the inclined plane.

Expense of Transit.

Since this force of traction is the same for all velocities, it follows that, the load being the same, and temperature of steam the same, the quantity of steam consumed, supposing it to follow in a column, would be the same for a given distance, whatever be the velocity; and as the distance run, that is, as the velocity, for a given time. Consequently the expense, which I presume must be proportional to the amount of such steam so consumed, is the same for a given distance at whatever velocity run. Therefore if l be the load, d the distance, and e the expense.

$$e \propto l \times d.$$

For two engines would be required under the same circumstances to tow a double load, three a triple load, &c.; and hence it is reasonable to infer, that the expense of the same engine exerting a double, triple, &c. force, would not sensibly differ, if at all, from the same rule. Consequently, if for l we put (1) multiplied by $a\,l$,

$$e = (1 + \backsim \frac{h}{22})\, a\, l\, d \ldots (2)$$

where a is a constant to be determined from experience, and the sign $\backsim$ signifying the difference is used instead of the minus, because the expense can never be negative. Indeed, it is hardly fair to apply the theorem in descending planes, particularly unless the descent is less than 22 feet per mile, owing in the first

instance to the waste of steam by turning it off, and in the second to the breaks being generally used to check the descending velocity.

Now, according to the average experience on the Liverpool and Manchester Railway, the expense of transition, Mr. Dixon, the Company's intelligent engineer, informed me, is about a halfpenny per ton per mile, though there are other railways, I believe, in which it does not exceed a half this sum, or a farthing per ton per mile. Hence l being the load in tons, and d the distance in miles, we have in pence

$$e=(1+\frac{h}{22})\frac{l\,d}{2}\ldots(3)$$

Under any other circumstances the 2 must be changed into the divisor of a penny, which the cost of transport happens to be.

Velocity of Transit.

If we suppose a piston one-half the area of another, it must evidently travel with twice the velocity to consume the same quantity of steam at the same elasticity and temperature, and its force will, of course, be just one-half. Therefore a half load, under such a circumstance, would be driven with a double velocity. In the same way a third and fourth of a load would be driven with three or four times the velocity; and, generally, other things being alike, the velocity would be inversely as the load, the area of the piston varying as the load.

But supposing the piston and fire to remain the same, what would be the velocity of a double, triple, &c. load? This is a question which I am not aware has ever been satisfactorily answered, physically or experimentally. Indeed, on the received doctrine of airs, I do not think it admits of an answer. I shall endeavour to solve the problem physically, on the only reasonable principle I can imagine, and on laws of aeriform bodies published and constated with experiment by me fourteen years since in the Annals of Philosophy. Let it be distinctly understood, that not being quite certain of the principle alluded to, I do not offer it as a demonstrated solution; but I should be glad to see it brought to the test of experiment, and whenever it shall be I do not expect it will be found much in error. If so, it will have the merit of bringing within the grasp of physical science one of the most important points in the action of the steam-engine.

The principle referred to is this:—That the number of steam particles emitted every moment, drawn into the temperature of the steam, is always proportional to the heat simultaneously communicated by the fire to the water.

If, therefore, the heat communicated be uniform, and N denote the number of particles momentarily emitted, and T the true temperature of them,

$N\,T$ is a constant quantity.

But if E be the elasticity of the steam, and n the number of its particles contained in a given space,

$$E \propto n\,T^2,$$

by Prop. 8, Annals for May 1821, p. 345. And if V be the velocity of the piston, $n\,V$ is evidently as the number of particles of steam momentarily carried off or emitted. Therefore,

$n\,V \propto N$, and $T n V \propto N T$ a constant. Hence

$$E \propto n\,T^2 \propto \frac{1}{T\,V} \times T^2 \propto \frac{T}{V} \propto \frac{\sqrt{F+448}}{V},$$

(according to Cor. 2, Prop. 1, p. 98, Annals for Aug. 1821) F being the Fahr. temperature. But E, the elasticity, will be as the load or force of traction, and V as the velocity of the engine. Consequently

$$\left(1+\frac{h}{22}\right) l\,V \propto \sqrt{F+448}\ldots(4)$$

Moreover, because when the elasticity of steam, at its proper tension, is tripled, the right hand member of the equation will increase only about 5 per cent, we may consider this member constant for all practical purposes; and hence the velocity of transit, other things alike, will be inversely as the load and force of traction.

We are now in possession of three rules of comparison, as simple and correct as, I believe, it is possible, in the present state of our knowledge, to make them.

First, the force of traction on any plane inclining with the horizon h feet per mile, is

$$9\left(1+\frac{h}{22}\right)\text{lbs. up, or } 9\left(1-\frac{h}{22}\right)\text{lbs. down}$$

per ton, allowing the draught per ton on a level to be 9 lbs.

Secondly, the expense of transit per ton per mile is, in pence,

$$\frac{1}{2}\left(1+\frac{h}{22}\right)\text{ up, or }\frac{1}{2}\left(1-\frac{h}{22}\right)\text{ down,}$$

supposing the steam at all times to act as the motive or retarding power.

Thirdly, the speed, if it be 30 miles per hour on a level, is

$$\frac{30}{1+\frac{h}{22}}$$

We can hardly apply this formula to descents, unless they are very small; for if the descent was 22 feet per mile, it would make the velocity appear to be infinite in consequence of gravity doing all the work, and the object to be propelled amounting, therefore, to nothing.

For the more readily examining the capabilities and economy of any line, I have computed the subjoined table. The last column was computed by multiplying the third by 30, and as the succeeding decimals were not taken into account, it may not be quite correct in the decimal figure; but it is quite near enough for any practical purpose.

Elevation per mile in feet.	Force of Traction, in pounds, per ton.	Parts of a Load	Expense per ton per mile in pence.	Velocity per hour in miles.
0	9·00	1·00	·500	30·0
2	9·82	·92	·545	27·6
4	10·64	·85	·591	25·5
6	11·45	·79	·636	23·7
8	12·27	·73	·682	21·9
10	13·09	·69	·727	20·7
12	13·91	·65	·773	19·5
14	14·73	·61	·818	18·3
16	15·55	·58	·864	17·4
18	16·36	·55	·909	16·5
20	17·18	·52	·955	15·6
22	18·00	·50	1·000	15·0
24	18·82	·48	1·045	14·4
26	19·64	·46	1·091	13·8
28	20·45	·44	1·136	13·2
30	21·27	·42	1·182	12·6
32	22·09	·41	1·227	12·3
34	22·91	·39	1·273	11·7
36	23·73	·38	1·318	11·4
38	24·55	·37	1·364	11·1
40	25·86	·35	1·409	10·5
45	27·41	·33	1·523	9·9
50	29·45	·31	1·636	9·3
55	31·50	·29	1·750	8·7
60	33·55	·27	1·864	7·1

JOHN HERAPATH.

Kensington, June, 1835.

REPORT OF MR. KINGSTON, ENGINEER, HIS MAJESTY'S DOCK-YARD, WOOLWICH, ON MR. CUNNINGHAM'S SHIFTING PADDLE-WHEEL.

Sir,—It is not a very long time since I was under the necessity of writing a short history of my understanding. This was drawn by the questions put to me by Mr. Cunningham, when I disallowed him the claim of originality; after which he gave us to understand, that the Lords of the Admiralty had examined his wheel, and "all admired it" ("for its simplicity," I presume?) It is said also, in the same letter, that Mr. Kingston was ordered by the Admiralty to examine the wheel, and report to their lordships upon the same. Mr. Kingston, no doubt, faithfully discharged his duty. But which way, think you, Mr. Editor, did the wind blow? Why, against Mr. Cunningham's wheel, and sent it a-shore. The letter which Mr. Kingston sent to the Admiralty, as a "Report," was sent through Captain Warren, C. B. Mr. Cunningham refers your readers for a sight of it to "the Minutes of the Admiralty;" but to save them this trouble, I now send you a copy of the same, by permission of Mr. Kingston; and as it is the Report of a intelligent practical man on a subject of great practical importance, I doubt not you will deem it well meriting a place in your pages.

I remain, Sir,

Your obedient servant,

MOHAMMED AL MOONGHEE.*

Woolwich Dock-yard, May 25, 1835.

Mr. Kingston's Report.

Woolwich Yard, Sept. 9, 1834.

Sir,—I beg to state that I have, agreeably to your orders, directed my attention to the mode proposed by Mr. Cunningham for reefing the paddle-wheels of steam-vessels, and I am inclined to believe that the method alluded to will be attended with considerable difficulties.

In the first place, it will require considerable power to connect the parts of the wheel, and I see no other way to effect this object without the introduction of shackle-screws, of sufficient magnitude, or equal in strength, to the sectional area of the polygon or rim of the wheel. It must also be observed, that

* My former communications were subscribed "Mashdoud Mohandez," from a wish not to obtrude myself on the public notice; but my friends having discovered me under that signature, there is no longer any use in keeping my real name a secret.—M. al M.

the number of fixed arms in the wheel will have to be so increased in dimensions, as to equal the quantity contained in the wheel, as those which move on centres can only be considered as trusses.

The moveable arms of the wheel will require to be strengthened by cross braces, in order to resist any strain opposed to them sideways, and the centre bosses will also require to be of greater diameter than usual, especially at those parts where the arms move. Therefore, taking all things into consideration, I am of opinion that the additional weight, which will be required to make the wheels of sufficient strength, as proposed by Mr. Cunningham, will require the same *length* of *time* to connect and disconnect, as would be found requisite in the ordinary way, when taking off a sufficient number of paddle-boards. The latter has been effected, when the hook-bolts have been properly attended to, in the short space of from thirty to forty-five minutes.

Under all these considerations, I think the proposition before stated will fall short of the means already in general use, and will be of no benefit either as regards time or other matters connected.

I am, Sir,
Your very obedient and humble servant,
JOHN KINGSTON.

Captain Warren, C.B.,
Superintendent.

IMPROVEMENT ON SIDE BELL-LEVERS.

Sir,—A short time since I was requested by a paper-hanger to repair some bells which he had put out of order. On examining the "levers," I found that he had forced some of them off from the wall, in order to lay the paper, and others had been drawn off from the spindle, the chain being nearly twisted from the barrel. In order, therefore, to enable paper-hangers to work without injuring the bell-hanging machinery, I would suggest that the lever should be a separate piece from the chain-barrel, and made to take off and on by a small screw in front; the bell-hanger could thus take away the lever from the chain-barrel, until the paper is hung, when the lever might be replaced, and without putting the bells out of order. Requesting you will give this suggestion publicity,

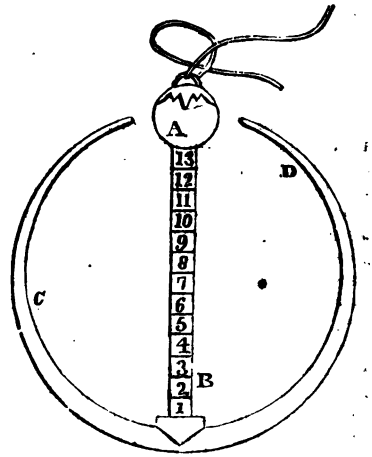
I have the honour to remain, Sir,
Your most obedient servant,
ISAAC BRIDGES,
Bell-hanger.

Waterloo-street, St. Hilliers, Jersey,
May 11, 1835.

A LEAF FROM AN OLD BOOK, 1634, ENTITLED—"THE MYSTERIES OF NATURE AND ART, BY J. B."*

There are divers fashions of weather-glasses, but principally two: the circular glasse, and the perpendicular glasse, either single, double, or treble.

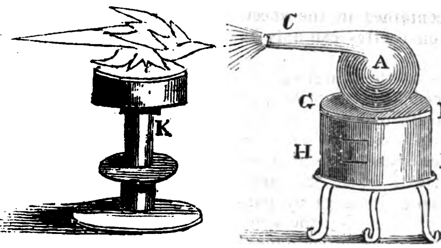
How to make the Circular Glasse.



First, you must prepare two glasses, the fashion whereof let be like unto the figures marked with the letters A B and C D. The glasse C D is open at both the ends; also in the middle there is a neck coming up of sufficient wideness to receive the shank-end of the glasse A B. Then fill the glasse C D a third part with either of the waters, and divide the glasse into so many equal parts as you would have degrees; rarifie the ayre in the head of the glasse A B by holding it to the fire, which being yet warme reverse the shank of it into the glasse C D. Note, that if the water do not ascend high enough, you must take the glasse A B out againe, and heat it hotter; if it ascend too high, heat it not so hot. If it be in the dog-dayes, and extreme heat of summer, 1 and 2 are good degrees; if the weather be most temperate, then 3 and 4 are best; if a frost, 9 or 10. When you have hit an indifferent degree, lute the joynts very close, and fasten a ribben unto the top of the glasse to hang it by. In this glasse the water will with cold ascend the glasse A B; with heat it will descend the glasse A B, and ascend the hornes of the glasse C D.

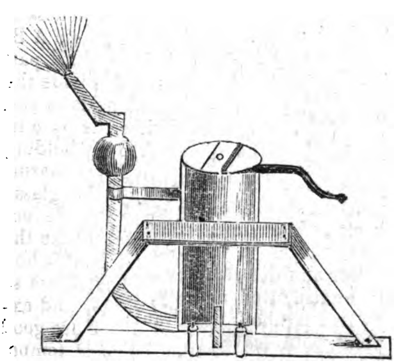
* Communicated by Mr. J. White, of Wells.

A Device to bend Glasse Canes, or make any small Worke in Glasse.



Let there bee a vessell of copper, about the bignesse of a common foot-ball, as A. Let it have a long pipe at the top as B, which must be made so that you may upon occasion screw on lesser or bigger vents made for the purpose. Fill this one-third part with water, and set it over a furnace of coals, as F G H I, and when the water beginneth to heat, there will come a strong breath out of the nose of the vessell, that will force the flame of a lampe placed at a convenient distance as K. If you hold your glasse in the extension of the flame, it will melt suddenly, so you may work what you will thereof.

The Description of an Engine to force Water up to a High Place, very usefull for to quench Fire amongst Buildings.



Let there be a brasse barrell provided, having two succurs at the bottom of it; let it also have a good large pipe going up one side of it, with a succur nigh unto the top of it, and above the succur a hollow round ball, having a pipe at the top of it, to screw another upon it, to direct the water to any place. Then fit a forcer unto the barrell, with a handle fastened unto the top. At the upper end of the forcer drive a strong screw, and at the lower end a screw-nut. At the bottom of the barrell fasten a screw, and at the barre that goeth crosse the top of the barrell let there be another screw-nut. Put them all in order, and fasten the whole to a good strong frame that it may be steddy, and it is done. When you use it, either place it in the water, or over a kennel, and drive the water up to it, and by moving the handle to and fro it will cast the water with mighty force up to any place you direct it.

How a Man may walk safely upon a high Scaffold, or piece of Timber, without danger of falling.

This is easily performed by wearing a pair of spectacles, whose sights must be made so gross as that he which weareth them may not discern any thing a farr off, but at hand onely. For it is the sight only of the steepnesse of the place, that bringeth the fear and overturneth the brain. By this means, I have heard, that the English man, which displayed an ancient upon a scaffold near the top of the pinacle of Paul's steeple, did help himself in his desperate attempt.

To whiten Copper.

Take a thin plate of copper, heat it red-hot divers times, and extinguish it in common oil of tartar, and it will be white.

To soften Iron.

Take of allum, sal-amoniacke, tartar a like quantitie of either, put them into good vinegar, and set them on the fire. Heat your iron, and quench it therein.

A good Cement for broken Glasses.

Take raw silk, and beat it with glasse, and mix them together with the white of eggs.

To soder on Iron.

Set your joint of iron as close as you can, then lay them so in a glowing fire. Then take of Venice glasse in fine powder, and the iron being red-hot cast the powder thereon, and it shall soder of itself. If you clap it in clay it will be the surer way.

LODDIGES' BOTANIC GARDEN.

We entirely agree with our worthy correspondent, Mr. Henry Watson (see Mech. Mag. page 56, of the present volume), that "we"—our friends the mechanics, and, alas! ourselves also—"who are 'in populous cities pent,' should be induced to devote some portion of our time to the simple operations of horticulture." Through the kindness of Messrs. Loddiges—a kindness which they extend to all respectable persons—we have recently indulged ourselves in a visit to their splendid establishment at Hackney,—an intellectual as well as a physical gratification of no mean order. We did intend to say something, as from ourselves, on this refreshing subject; but we have found, suited to our hand, a very interesting paper, contributed by another esteemed correspondent of ours, Mr. Archibald Rosser, some years ago, to the London Museum, a periodical projected by Mr. John Valpy, the well-known classical printer. As that publication has long ceased to exist, and as its circulation was very limited, we do not scruple to present this paper as new matter, in the hope of stimulating some of our "pent up" friends to relax themselves with the innocent and healthy occupation of gardening.

There is a degree of enthusiasm in some minds, that gives an exquisite zest to the enjoyment of intellectual pleasures arising out of the contemplation of the works of nature, or the most important achievements of human power. This extreme sensibility, no doubt, renders the woes of life more afflicting to those who bear it about them, than they would be to others who possess it not; but at the same time is productive of the highest mental gratifications. I must ever remember the first time I stept on the terrace at Richmond Hill. All circumstances conspired to make that well-known landscape, which at once burst on the eye from the eminence, most delightful to me. The day was beautifully fine—towards the end of the summer—ere the brown tints of autumn had mixed to any decided extent in the dark-green foliage below. The season's heat had, for some weeks, been so frequently tempered by refreshing showers, that the meadows wore the hue of spring. The shadows of some heavy, yet not threatening, clouds gave depth and body to the mass of verdure; while that enchanting feature of the rich picture, the broad expanse of the silver Thames, dotted across by a line of cattle quietly standing in its cool stream, threw a finishing lightness on the whole. The full force of the enthusiasm of taste bore on my mind. A similar feeling has often been roused by the passing banners of our intrepid warriors, unfolding, in their undulations, the names of places rendered immortal by the victories of British arms. A venerable abbey—the tomb of a great and good man—the ocean in its rage—these, and other objects of equal interest, cause an expansion of the heart, the value of which can be appreciated by the enthusiast alone. They flash a sunshine on the mind, amply compensating for the endurance of all the darkness which it disperses.

I am yet enjoying such an excitement, experienced, a few days ago, on entering the great hot-house of Messrs. Loddiges', the indefatigable horticulturists. Their taste has led them to erect, in their conservatory, which is devoted to tropical plants, a stage,* from which a most magnificent spectacle of vegetation presents itself at one view. The immense plantain, not as in its wild state, torn by winds and deformed by insects, but in all its undisfigured majesty, is rivalled only by its neighbour the Urania. The latter plant, with leaves of twenty-five feet in length, and nearly three in breadth, almost overwhelms the senses of those who have seen none but the productions of our ordinary gardens. From the platform, which the visiter is directed to ascend, he sees palms, fanleaved, and of

* This stage is now removed, the plants have outgrown it, and they are now each viewed from below.

every character of that "royal race," as Linnæus terms the genus, in profusion. For my own part, I should scarcely have been surprised, had I seen the tiger creeping with wary malignity, or the elephant, in untamed activity, throwing up his proboscis, beneath their high-arched foliage.

But it is time to descend from my eminence and give (if I can), not a full description, but some faint and sober idea of this romantic place; and I much mistake, if even those who are not botanists will not be gratified by it.

The proprietors of the garden, a venerable German* and his two sons, have, on little more than twelve acres of ground, situated on the eastern side of Hackney, collected almost every vegetable production that the best inventions in horticulture (the very best being their own) can preserve in our climate. As well as increasing stock can be calculated on, they possess not fewer than 18,000 vegetable productions *of different* species; more than half of which are *rare*, and some *unique*, in this country. The hot-houses are warmed by steam-pipes, ingeniously arranged, and supplied by a double apparatus; so that, in case of an accidental failure of the water or fire for the one, the other may preserve the precious collection. Both the hot-houses and green-houses are veined throughout their roofs by fine metallic tubes, perforated at proper distances, by means of which gentle showers, resembling the natural rain, are at pleasure let fall on the plants beneath.

At this delightful repository may be seen, full of life and vigour, plants of all magnitudes, from the little aretia of the Alps, which, with its profuse yet delicate blossom, does not lift its head above an inch and a half from the earth, to the magnificent musa paradisiaca (the plantain), which towers forty feet from its root, though, in fact, it is merely an enormous esculent, possessing nothing of the character of timber.

To attempt to describe the elegance and splendour which reign here, would be vain. Forms pyramidal, spiral, waving, present themselves on all sides. Flowers of the most brilliant hues, either uniform or variegated, bewilder the eye like a rapid succession of objects in a kaleidoscope. Even leaves, such as those of the maranta zebrina, if viewed apart from the other beauties of the place, would excite the highest admiration. In many instances nature seems to have been playful in her works, and to have indulged in downright bizarrerie; as in some uncommon plants of the cactus tribe.

Here the classical visiter will be introduced to the true Alexandrian laurel, of the very species which in ancient times rewarded the hero and the bard. Here, too, he may muse over a specimen of the Heliconia, from Mount Helicon, the papyrus, and the sacred lotus.

Our fair countrywomen will be delighted to see, in actual growth, things familiar to them in other shapes,—tea, bohea and green—coffee, chocolate, cocoa, cinnamon, cloves, ginger, pimento, nutmeg, and arrow-root.

Here are also the date, the areca (producing the betel-nut, with which the Chinese beaux and belles dye their teeth of a red colour), the mango, the bread fruit-tree, the camphor, the sugar-cane, the bamboo, the plant that yields the gum of which Indian-rubber is manufactured, and the only teak tree that ever lived in this country.

There are some vegetables which our limited knowledge leads us to call poisonous; though it may fairly be conjectured that they afford powerful medicines. One of the most prominent of these, which cannot without risk be touched with the naked hand, so nearly resembles a snake in colour, shape, and dimensions, that no animal, aware of the dangerous properties of the serpent tribe, would approach it incautiously—this is the caladium seguinum, or dumb cane; the juice of which, when it enters the human frame, besides being otherwise detrimental, paralyses the faculty of speech for a time.

The jatropha urens, upon being touched, however lightly, produces the effect of a sharp sting.

Those who have been delighted with the peculiarity of the sensitive plant, will be further gratified by the hedysarum gyrans; the younger leaves of which, under a warm sun, are constantly in spontaneous and rapid motion. The dionæa muscipula may also be noticed with the sensitive plant. This vegetable bears a kind of a pod, which opens like the shell

* The good old man has paid the debt of nature since this paper was first published.

of a cockle, strongly jointed near the stem that holds it. Within the pod are a number of fine fibres, and the instant any insect enters the pod and touches either of these fibres, the shells close on their victim, and hold it fast until death has deprived it of motion, when they return to their former position.

Here may be seen the air plant, a species of the epidendrum, suspended in baskets, and having no communication with earth or water; yet vegetating in strong luxuriance, and blossoming, supported solely by the nourishment that it derives from the surrounding atmosphere.

The garden contains no fewer than 1260* different species of roses, forming a gulistan which probably even Persia herself does not outvie.

In short, in this collection, the first in the world, and approached only by the botanical garden at Vienna, have these persevering cultivators, in every region from the tropics up to 76 degrees of latitude, gathered something rare, beautiful, curious, or majestic, whether vegetating in air, in earth, or in water.

But what gives the most steady gratification, are some objects of humble appearance, and which, to an unexperienced eye, require for their detection some of that good-natured explanation that is always afforded to inquiring visiters by the Messrs. Loddiges. These show the kind bounty of Providence towards animals in its government of the vegetable kingdom.

I will instance but one, the nepenthes distillatoria, or pitcher plant, which grows in great abundance in stagnant, fetid swamps. This "spring in the desert," is in shape like a tall jug, and has over it a cover resembling that with which some old-fashioned silver tankards are furnished. When at full size it is about six inches in height, and one in diameter. In those unwholesome marshy places in India, and particularly in Ceylon, where pure water is not easily to be met with, the nepenthes filters the necessary element, through the fine fibres with which its lower extremity is lined. The cover then closes of itself, to exclude insects and vermin, and to prevent evaporation, and the plant remains ready to supply men and cattle with its crystal contents.

* Now (1835) 1485 different species.

Atheist! though I almost doubt whether there really does exist such a character to answer the appeal—if neither the contemplation of the all-glorious sun, nor that of the starry heavens, have taught thee the lesson of truth; if thou hast been deaf to the voice of the thunder, blind to the light of the heavens; if neither the fragrance of the balmy gale, nor the gratefulness of juicy fruits, nor the refreshing coolness of the limpid stream; if none of these delights have entered into thee, for aught but sensual enjoyment, through thy clouded senses, betake thyself, with thy cold philosophy, to the examination of the wonders of the vegetable world. If that does not convince thee that there is a ruling Providence, Almighty and All-good, continue in thine own dreary fancy, the creature of blind chance—an ephemeris—the being of a day—come into the universe only to vanish from it. For myself, I am willing to live in the belief that "there is a God that governs the earth." Not a bird that carols from the spray—not a blade that points its rich luxuriance to the sky—not a beetle that spreads its gemmed armour to the sun, but proclaims the glorious truth. In this happy conviction, which constantly calls for gratitude and praise—the most delightful exercises of the mind—I live, and hope to die; while thou—but surely I am addressing an unreal mockery. There never was (whatever shape the pride, or the self-sufficiency, or the hypocrisy of man may assume), nor is, nor ever will be, a real atheist.

EVIL EFFECTS OF THE DIVISION OF LABOUR.

In attempting to prove that the minute subdivision of labour has an evil tendency, I am aware that I shall meet with few who will admit the evil to be so extensive as I shall endeavour to point out; and it is very probable I shall be written down by some of the many able correspondents of the Mechanics' Magazine. But as the following facts are the result of long observation and experience among the working classes, I have resolved to publish them anonymously, in the hope that they will meet the eye of some who may be benefited by them; and should they be the means of convincing even one, I shall consider myself happy

in having brought the subject into notice. I have myself served an apprenticeship to a mechanical profession, and had then ample opportunities of observing the causes that tend to bring about the moral degradation of some of the working classes.

That the division of labour produces a cheaper article, and is a great source of national wealth, I readily admit. I believe were it not for this very cause, Britain would ere this have lost her political status among the nations. Groaning under a load of taxation, which no other nation on earth could have borne, we have been driven into an artificial state of society, and the division of labour with all its attendant evils is one of the results. This is illustrated by the fact that we export machinery to countries where workers are obtained at half the price: and yet these countries are unsuccessful competitors in the same market with the poor tax-eaten British. Our national vanity whispers that this is owing to our superior genius; but I contend that it is our artificial mind-degrading system of dividing labour, which by making individuals do only *one part of a thing*, with mechanical, or rather slight-of-hand, rapidity, enables us to produce a whole as cheap as our foreign brethren.

But the effects of this system upon society is truly deplorable. A poor boy, with very little education, is bound an apprentice for five or seven years, to do one particular act; he commences cheerfully, and in a few weeks can manage it completely; the only difference between him and a journeyman being, that he takes twice the time. He is now doomed through life to be a *mere machine;* all the delight he felt in learning his trade is over; he has no more mental work to perform, and he goes on from day to day with his monotonous task without excitement of any kind, save the temporary one of the gin-shop: there, amongst the rudest ribaldry and mirth, he is exhilarated and *comparatively* happy. Next day he returns to his labour in the most melancholy and discontented mood, and hastens on with his work to procure the means for "a hair of the dog that bit him." In short, as his profession does not exercise his intellect at all, he cannot fail to indulge in what *he* thinks his only pleasure. Let us suppose this to be continued until he reaches man's years, when the effect will be seen in an intellect, blunted, and quite useless from inaction. For we know well, that the thinking, like the physical, part of the man is, either perfectly or imperfectly developed—by proper or improper exercise. This man's brain is unexercised, nay, it is diseased; he has acquired a sensual and ungovernable appetite for the drug that enfeebled, and still continues to enfeeble, both his mind and body, and he is in such a morbid state, that all his efforts to reform or improve his mind are ineffectual. He tries Mechanics' Institutions, and all the other schemes for improving the working classes, but to no purpose; his mind, from want of habit, cannot follow the lecturer; he gets inattentive—sleeps—and loses the thread of the subject; repeats his visits for a night or two, perhaps, and the lectures get to him "the longer the drier," until he quits in disgust, what might, under other circumstances, have been a source of enjoyment to him. When such a character enters into the solemn engagements of matrimony, his previous habits and badly regulated mind, ill qualify him for the various duties of husband or father; he brings into the world a few squalid, degenerated wretches, and by his brutal conduct, drives his well-disposed partner to that temple of infamy the gin-shop, for the melancholy purpose of "drowning her cares." I will not disgust the reader by dwelling upon the united effects of their example on their thus hereditarily vicious offspring. The wretched man continues to work and drink alternately, until he reaches the workhouse if in England, and beggary and crime if in Scotland; a poor grumbling, discontented, shameless pauper, both unable and unwilling to work; for the man who has spent twenty years of his life sharpening pin-points, or guiding a self-acting turning machine, has not physical strength to handle a spade or road hammer, even if he had not been previously wasted by dissipation. This is not an exaggerated picture; the melancholy details of evidence brought before the Factory Commission, furnish multitudes of such instances. It is not the long hours, however, that is the sole cause of this evil I maintain, it is the division of labour that is the root of the evil, which I shall endeavour to illustrate by another example, *not ideal*, but like the former, *real;* and the writer

has many characters under his own eye, of both kinds, to choose from.

In Scotland, some ten or twelve years ago, the division of labour was not (and is not even now) carried to the extent, that it is in England, and consequently, the working classes have a higher moral character, which is commonly ascribed to education, and a modern training. This is the case in a very few instances;—by far the greater number of the Scotch mechanics and operatives receive a very limited education. When they are sent off to a trade, they can half read, and perhaps make shift to write the letters of their own name; but the difference rests here;—the Scotch mechanic has to do a great variety of jobs, not one of which he can do so quickly as the expert Englishman.

As an instance:—About twelve or fourteen years ago, an engine-maker had to learn to make a tolerably good pattern; he had to turn both iron and wood, to fit up, put together, and attach the engine to the factory; he had thoroughly to understand drawings, and in many cases had to draw himself. The reader will readily imagine, that this must be a clumsy "Jack of all trades:" this is not the case, however,—he is a slow, but a good workman. Suppose exactly such a boy as we took in the former case, bound apprentice to this trade for seven years: for one year he is allowed to run loose about the work, he is every "body's body," runs messages, creeps into holes to do jobs which men cannot reach. By the end of the year, he has acquired a very rude general notion of the whole work, but can do little or nothing with his hands. He is now stationed at a bench, and from making simple articles, comes on with great satisfaction to himself to make good patterns; he then wearies, because he thinks himself master of the subject; having little mental work to perform, he is now in great danger of going astray, but happily for himself he is shifted to another department, upon which he enters with great spirit, and feels with intense delight, as bit by bit he masters the various tasks put before him. His brain thus stimulated and exercised, a thirst for knowledge is created, and he is driven in search of food for his mind to Mechanics' Institution where he hears and sees, for the first time, the astonishing fact, that the water he drinks is composed of two gases that burn. This leads him to endeavour to read that he may learn more of the matter, but he finds he cannot do it so quickly as he would like; he then sets to work with good will, goes to an evening-school, and his mind being in an excellent state for receiving instruction, he makes most rapid progress. I need not trace him farther—here is a useful and promising member of society who himself enjoys life and all its blessings. A few such (according to the strength of their intellect) turn out eminent men—the rest are scattered over the earth in the shape of managers, superintendents, and foremen, of flourishing works; and it is worthy of remark, that in all the large manufacturing towns in England you find a large proportion of Scotchmen doing the intellectual work of large mechanical establishments. This does not arise (as Sandy's vanity always suggests) from a "national superiority"—John's head is just as good as his, as is seen in every case where there has been the same chance of getting the organs developed. I regret to state that the baneful system of dividing labour is fast spreading in Scotland, and the moral degradation attending it cannot be denied by the most ardent admirers of the religion and morality of that country. It must not be supposed that the character I have last attempted to describe has been exempt from temptation. No, he has kept company with the drunken and the dissolute (of which there must be a large proportion in every society); but his mind having been properly set to work, he soon calculated the amount of real pleasure or pain to be derived from seeking after knowledge, or from a course of profligacy. Nor must I be understood as assuming that all are depraved who labour at one particular object all their lives, for there are some minds that naturally resist the influence of such causes; but the number of the good bears a small proportion to the bad in countries where this vicious system is carried to great extent. There is another demoralising effect yet to be noticed, which I shall endeavour to do as briefly as possible. An improvement in machinery often turns hundreds adrift upon society, who having spent the best part of their lives in some such trifling work as heading pins, are too old to learn another

business, and for reasons already mentioned they cannot do out-door work; their minds being untutored they do not make a very vigorous effort to do their best at a new job, well knowing that they will not be allowed to starve in England. In many, very many cases, such men direct their blind rage to the breaking of machinery, not only the machine which superseded them, but machinery of all kinds; in short, a large proportion of the seditious, the incendiaries, the Swings, machine-breakers, &c. which disturb the peace of society, are division-of-labour people, thrown out of work, and who have neither physical nor mental strength left to turn themselves to another decent employment, seeing that the few that do so, are scarcely fit to earn sufficient to support a miserable existence.

It is common enough to hear the *lordly* aristocrat, or wealthy man of business, express their *disgust* in such unmeasured terms, as the "beastly multitude," the "canaille," the "scum of the earth," &c., and grumble loudly at the overwhelming poor-rates. Let them examine themselves carefully, and see that they be not aiders and abettors of such infamy. Let them remember, that the cause of this evil is *over-taxation* (and every one who directly, or indirectly, robs the public purse, is to blame for perpetuating the evil), and not turn away in disgust from his fellow-being whom he has already injured.

We take some trouble to educate the lower animals, and if some of these our humble servants are not so tractable as could be wished, we do not vent our anger upon them, but upon their trainers. Why, then, should the higher classes *spurn* the poor, misled, untrained mechanic, whose labour has perhaps enriched them? It were a wiser course, and a way to root out the evil, were they to set on foot a proper plan of national education, inquire into, and amend, some of the absurd apprentice-laws, and put the rising generation in the way of acquiring more than one branch of a business, in order that their minds may be so far exercised as to make them good members of society, instead of converting them into *mere machines* for the acquisition of wealth. We see the good effects produced in the middle classes by education. Why, then, should a large proportion of our fellow-creatures be allowed, or rather doomed, to remain in a state of darkness? I trust these remarks will be followed out by some of your abler correspondents at some future period. I am afraid I have already occupied too much of your valuable space.

L.

May 4, 1835.

SOCIETY OF ARTS' PRIZES.

At the annual distribution of prizes by the Society of Arts, which took place on the 8th inst. at Exeter Hall, the following rewards were given in the class of *Mechanics*:—

1. To Mr. H. Powell, for a slow motion for the stage of a microscope. The silver Isis medal.
2. To Mr. H. Goadby, for a microscope, and instrument for dissecting insects. The large silver medal.
3. To Mr. W. Maugham, for an oxy-hydrogen blow-pipe. Silver Isis medal.
4. To Mr. J. Roberts, for a jet for an oxy-hydrogen blow-pipe. Five pounds.
5. To Mr. R. Knight, jun., for experiments on the texture of steel as affecting magnets formed of it. The silver Isis medal.
6. To Mr. A. Mackinnon, of Sheffield, for a permutation lock. The silver Isis medal.*
7. To Mr. J. Franklin, for a machine for making tops of umbrellas. The silver Isis medal and five pounds.
8. To Master W. J. Flight, for a method of preventing heavy weights from falling when the rope breaks. The silver Isis medal.
9. To Mr. Theod. Boehm, for a method of communicating rotary motion. The large silver medal.
10. To Mr. Is. Dodd, Horsley Iron-works, for a parallel motion for steam-engines. Large silver medal.
11. To Mr. W. Maclaurin, for a machine for stamp-engraving. The large silver medal.
12. To Mr. S. Howlett, for crayons for drawing on glass. The large silver medal.
13. To Mr. G. H. Pearce, for his relieving stopper for a ship's steering wheel. The large silver medal.
14. To ditto, for a signal lantern for ships. The large silver medal.
15. To Mr. W. Rooke, for an addition to the Jacquard loom. Five pounds.
16. To ditto, for a frame for brocading silks. The silver Isis medal and five pounds.

* We congratulate our worthy correspondent on this well-earned distinction. His lock is of a simple yet very ingenious description.

MONUMENT TO JAMES WATT IN WESTMINSTER ABBEY.

The following lines have just been inscribed on the Monument to WATT, in Westminster Abbey, by CHANTREY:—

NOT TO PERPETUATE A NAME,
WHICH MUST ENDURE WHILE THE PEACEFUL ARTS FLOURISH;
BUT TO SHOW
THAT MANKIND HAVE LEARNED TO HONOUR THOSE
WHO BEST DESERVE THEIR GRATITUDE,
THE KING,
HIS MINISTERS, AND MANY OF THE NOBLES
AND COMMONERS OF THE REALM,
RAISED THIS MONUMENT TO
JAMES WATT:
WHO, DIRECTING THE FORCE OF AN ORIGINAL GENIUS,
EARLY EXERCISED IN PHILOSOPHICAL RESEARCH,
TO THE IMPROVEMENT OF
THE STEAM-ENGINE,
ENLARGED THE RESOURCES OF HIS COUNTRY,
INCREASED THE POWER OF MAN,
AND ROSE TO AN EMINENT PLACE
AMONG THE MOST ILLUSTRIOUS FOLLOWERS OF SCIENCE,
AND THE REAL BENEFACTORS OF THE WORLD:
BORN AT GREENOCK, M.DCC.XXXVI.,
DIED AT HEATHFIELD, IN STAFFORDSHIRE, M.DCCC.XIX.

INQUIRIES.

A subscriber residing in Paris requests the following information:—

1st. What has been the result of the experiments made with Mr. Ericsson's caloric-engine, described in the Mechanics' Magazine about eight months ago? A French engineer here, who has been long engaged in endeavouring to apply heated air as a motive power, thinks he has corrected some of the difficulties which he presumes Mr. E. has encountered.

2d. The same person having invented and put into operation a machine for making netting, by which one man performs the labour of thirty by the ordinary mode, wishes to dispose of his invention in England. No patent has been taken, nor has the machine been exhibited to the public. It costs about 100*l.*, and can be suited to meshes of any size. He inquires whether it would not be a valuable acquisition for fabricating nets for the herring fishery? [Specimens of netting manufactured by this machine may be seen at the Mechanics' Magazine office.]

3d. Has Mr. Dean's diving apparatus superseded the use of the diving-bell? And, if not, what disadvantages attend it?

Paris, June 1, 1835.

NOTES AND NOTICES.

London and Greenwich Railway.—On Monday last a number of shareholders and directors of this undertaking met on the works, near the Blue Anchor-road, to witness the experimental running of the Company's locomotive engine "The Royal William." A distance of one mile was performed in about four minutes. A glass of water, filled to the brim, was placed on the block holding the rail, in order to ascertain the degree of vibration, when the engine, with the tender with water and coal, and several passengers, the whole train weighing at least 14 tons, passed along. Not a drop of water was spilled, nor was any vibration perceptible. Persons who stood under the arches when the engine passed over, were astonished to find that the noise was no greater than what would be occasioned by the passing of a hackney-coach.—*From a Correspondent.*

The Patent Laws.—We have received a copy of Lord Brougham's Bill, and shall lay it before our readers next week. Meanwhile we may venture to assure the numerous correspondents who have written to us—some of them with much anxiety—on the subject—that they may rest very much at their ease. If they have nothing to hope from it, neither have they any thing to fear. The bill can never pass as it is; and to mend it, we take to be about as difficult a task as mending the Highlander's pistol, which wanted a new barrel, new lock, and new stock. It meets but one or two of the many defects in the existing system, and that in the clumsiest and most inefficient manner imaginable.

Mr. Erle's address is Dorking, Surrey.

Communications received from Trebor Valentine—Mr. Harvey—Mr. Roffe—Mr. Baddeley.

The Supplement to our last Volume, containing Titles, Index, &c., with a Portrait, on Steel, of Samuel Clegg, Esq., C. E., is now published, Price 6*d.*; also the Volume complete, in boards, Price 8*s.* 6*d.*

Our Publisher will give One Shilling and Sixpence for copies of the Supplement to Vol. IX.

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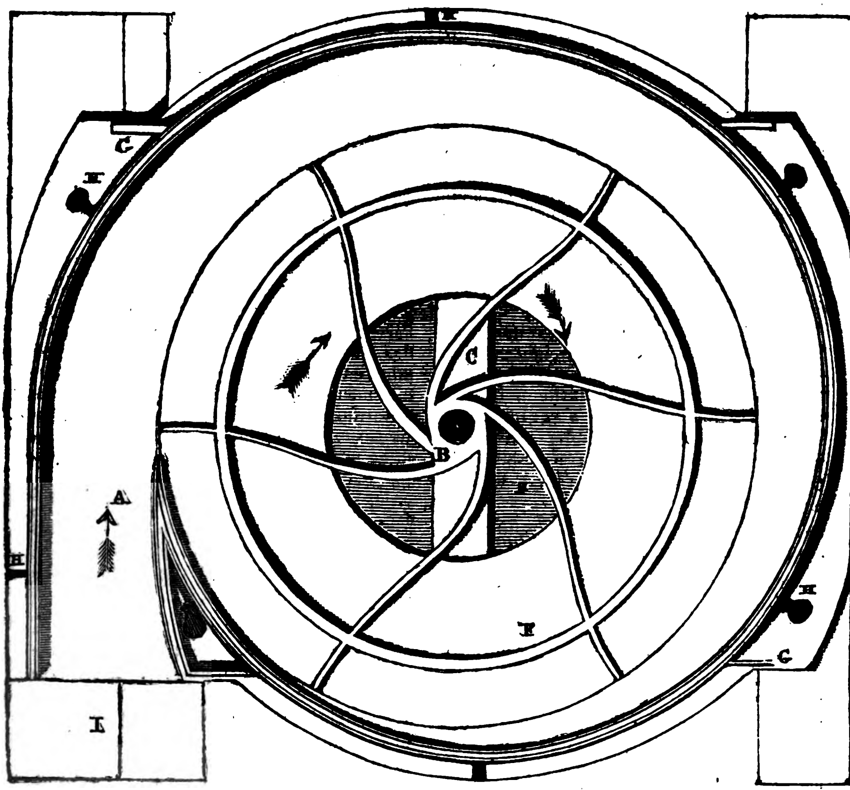
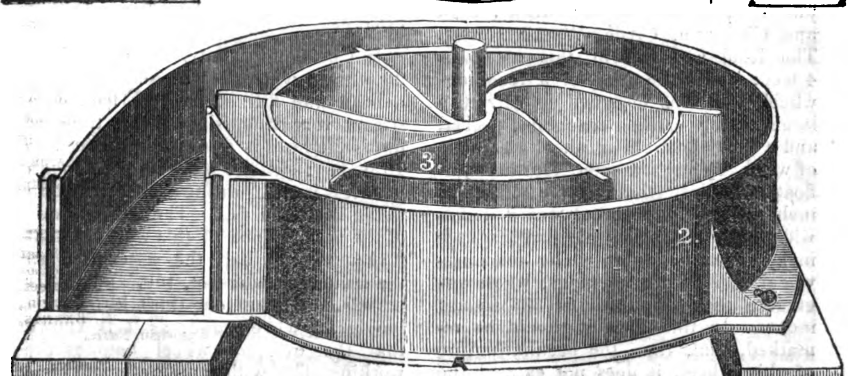
EASTMAN'S CENTRAL DISCHARGING WATER-WHEEL.





EASTMAN'S CENTRAL DISCHARGING WATER-WHEEL.

(From the New York Mechanics' Magazine.)

Sir,—I herewith forward to you a drawing of Joel Eastman's central discharging water-wheel, patented lately. The inventor died before he had brought it to that degree of perfection it has now attained. The undersigned being a joint patentee, has devoted considerable attention to this wheel, in order that he might present it to the public for their patronage, in a form that would do them, and the wheel itself, justice. This, he thinks, has now been fully attained. During the last year, many of them have been built and put in motion in the western part of New York, with a degree of success unprecedented. The wheel is adapted to all degrees of head and fall. It runs as well in backwater as out of it, the head being the same. In cold climates, where the ice is troublesome, this wheel is a relief from the difficulty, as it can be so placed that ice cannot form near it. It may be wholly buried in water to effect this object; in which case the shaft must be surrounded with a water-tight case, to prevent the water from coming into the wheel around the shaft, as that would injure its action.

In many instances this wheel has been put in comparison with those before in use, and in every instance the comparison has been very much in its favour. A few facts on this point will be stated in this place, believing they will be acceptable to your readers, and especially interesting to mill-owners.

The first wheel which the undersigned put in operation was for Messrs. Ford and Chapman, Clyde, Wayne county. The head and fall in this case was 4 feet; it took the place of a reaching-wheel, and was designed to carry two large double carding-machines, pecker, and a grindstone. The wheel was made of wood, 4½ feet diameter, four arms, or floats, morticed through the shaft, 12 inches wide. The throat was 8 inches wide, and 12 inches high=96 square inches area of water. The reaching-wheel had twelve openings, whose aggregate area amounted to 336 square inches. In this place it should be remarked, that, from the peculiar nature of this wheel, it does not expend the water so fast under the same head and aperture, as in the case of the wheels in common use. When the wheels run light, or without a load, the difference is one half; in other words, only half as much water is expended as would flow through the same aperture when the wheel is removed out of the way. This has been ascertained by experiment. When the wheel is charged with its ordinary load, the expense of water is one-third less than if discharged under the same head and aperture on an undershot wheel; so that in the case above, where the aperture was 96 inches, the expense was only equal to 62 inches.

When this wheel was set to work, it was found to exert more power than the reaching-wheel, which the millwrights in this case judged consumed from four to six times as much water. When the operation of fulling commenced, this wheel was found able to finish a stock of cloth in six hours that used to require eight hours by the reaching-wheel. This wheel was built and put in motion in three days by four men, and, as may be supposed from the above statement, gave great satisfaction. The proprietors, among the most intelligent mill-owners in the State, unsolicited, have furnished me with a statement of the performance of this wheel, certified.

Another wheel was put in motion in Eldridge. It took the place of a tub-wheel, 6½ feet in diameter, which received 280 inches of water. This wheel was 5 feet ten inches, used just one half of the water required by the tub-wheel to drive a pair of heavy rock cornstones, and with one half of the water it ground faster.

In Courtland county, there are about 20 of these wheels in use, generally with a head and fall of about 5 feet, on a stream very sluggish, and in time of floods the head is sometimes reduced to 16 inches; still the wheel goes, though with less power, bearing a just proportion to the head and fall. The general rate of the performance of this wheel is, that it requires only half the water used on the ordinary undershot, tub, and flutter wheels, and about one-third less than a low breast wheel; and, as it is known that the overshot wheel doubles the working effect with same water and head

used by the undershot, it follows from analogy that this wheel (being found to do the same) is equal to the overshot in its effect. It has not been tested against an overshot wheel, except in one instance, a common country mill; in this case it exceeded the overshot in effect, but it is not considered a satisfactory experiment. The undersigned, however, is so well convinced that it will equal the overshot in its performance, that he would not hesitate to put it to the test under a heavy forfeiture.

Millwrights, generally, when they first see the plan, are inclined to treat it with contempt; which, in every case that has come under our observation, has been subdued. When they have seen the wheel at work, they uniformly give it up, and admit that it excels all other wheels for low heads, although its being so small and simple puzzles them to account for the effect.

This wheel is also well adapted for saw-mills. When used for this purpose, the shaft is usually placed horizontal, and the wheel vertical. If the head is less than 6 feet, then the best way to apply it to sawing is to form the wheel of its usual size, varying from 4 to six feet, according to head and fall, and gear to the crank shaft by two small bevel wheels. There are several saw-mills in operation on both these plans; that is, when the motion is given directly to the crank shaft by the wheel being on it, and by gearing. The accompanying drawings represent one of these wheels, made entirely of cast iron, except seven screw-bolts, to secure it in its place upon a foundation of bed timbers. Fig. 1 represents a plan. Fig. 2, a view of the same in perspective. The circle in which the wheels revolve is 4½ feet, about medium size. Fig. 3 shows the wheel in its place, the floats being connected and supported by a ring of iron near their extremities. A represents the throat, by which the water is admitted, 10 wide by 13 high, forming an aperture of 130 square inches; B, on the plan, represents the wheel; C, the bed-piece, supporting the step of the shaft; D, the shaft; E, the opening in the bottom of the case containing the wheel, by which the water is discharged 2 feet in diameter, equal to 452 square inches. The general rule is to make the discharging circular opening about four times the dimensions of the aperture by which the water is admitted on the wheel; F, the ring of support to the floats; G G G, brackets to add strength; H H, &c., holes and notches, to admit of bolts to secure the whole together, and to bed the timbers, I I.

The top of the case, in which the wheel revolves, is not shown in the drawing; it is made to fit on the top edge of the rim, forming the spiral exterior of the wheel; a groove of slight depth is formed in it, to admit of making it tight. The throat enlarges outward, and at its extremity on either side is provided with vertical grooves, the more readily to admit of connecting it with the flume. A wheel of this size will weigh from 2000 to 2500 lbs., and can be put up, all expense included, for about 150 dollars. Nearly all the wheels in use are made of wood, in the following manner; viz. a course of 2½ or 3 inch plank is laid level in the bed timbers; the rim, or circumference, is formed of timber framed together at the corners, and curved out so as to form the proper inside shape. The top is to be formed also of plank jointed together, and the whole well secured together; an opening must be left through the top, to admit the shaft to turn freely, without rubbing.

The periphery of the wheel case varies as much from a true circle as is equal to the breadth of the throat. A convenient mechanical method of generating this spiral curve, is as follows: when the breadth of the throat is determined on, prepare a circular piece of wood, whose circumference is equal to the breadth of the throat; plant this circle exactly in the centre of the shaft; then fasten a small wire to the side of the circle opposite the throat, and in a loop prepared for the purpose, put the point of the scribe, and proceed to trace the curve; when an entire revolution is made, the wire will be wound once around the circular plane in the centre, and of course the radius will be shortened just the breadth of the throat. This is a convenient and true method of generating the required spiral curve.

In conclusion, it may be remarked that this wheel is entirely new; in form it is very simple, small in bulk, having

no friction except on the journal of the shaft, and the friction of the water in passing through the case. When the head and fall is eight feet and upwards, no gearing is necessary to give the proper motion to mill-stones; and when the head of water is below eight feet, single gearing, quite small, is all that is necessary. This wheel runs nearer the motion of the water than any other; and from the known effects of its operation, it clearly proves that water, when acting by its impulsive force, if such force can be intercepted, as is the case in this wheel, yields its maximum effect, equal gravity.

Having thus, sir, at some length, given a description of this new wheel, and the mode in which it may be constructed, should you deem it worthy, you are at liberty to give it a place in your valuable journal. The wheel must, in all cases, be properly portioned to the head and fall in any given case, and the power required.

I am, Sir,

Yours respectfully,

JOHN MARTINEAU.

M'CURDY'S PROPELLERS.

Sir,—I observe in your last month's Part, an anonymous writer assumes the descriptive name of "Fair Play;" but how far that title suits him, I shall leave your readers to judge, after I point out the *fairness* of the manner, with which he has met my objections to Mr. M'Curdy's propellers. Passing over the remarks about the construction of the propellers, which show *profound experience and mechanical knowledge,* I shall confine myself to the points wherein I have offended.

In the first place, then, "Fair Play" thinks I am sincere and charitable, when I wish the patentee joy of his invention. Admitted. For the man who can forget his own interest so far, as to take out a patent for a thing that requires so little reflection to see the absurdity of it, deserves "charity."

"Fair Play" infers, that the plan I tried was not the same as the one he defends; I have already stated that it was exactly the same in principle, but with two, instead of four paddles. My opponent makes a curious mystification about the "circumference of the cranks;" thus, "the cranks, in describing a circle of 18 feet, dip four paddles in the water, and in travelling 54 feet will dip twelve paddles." Now, to produce this effect, *three revolutions* of *the shaft* are requisite, while only *one* is necessary to produce the same number of immersions with a paddle-wheel having twelve arms. This is the simple state of the question; and the story about "circumference, space, &c.," seems intended to confuse the general reader. It must be obvious to every one who has examined the subject, that to drive a machine—such as the one in question—with so many moving parts, and of such a weight, at three times the speed of the common paddle-wheel, is very objectionable, and unsafe in a steamboat.

My "Fair Play-"ing antagonist next supposes a vessel must "heel sufficiently to dip the paddles 6 feet under water." Now, it is not 6, but 4 feet, that the paddle rises out of the water altogether, and the blades begin to make their return stroke at *one* foot above the water line; and some one of the three returning blades, are at all times within 15 or 18 inches of the water line. It will require no heeling to bury and counteract the propelling action; the very small waves passing along the vessel's side will produce this effect: and I happen to know this from experience. "Fair Play" then makes the extraordinary statement, "that the breadth of the paddles has nothing to do with the length of the cranks." Does one part of a drawing bear no proportion to another? Or are drawings of patent machinery done by guess? My opponent would do well to consult the figure he refers me to; and he will find by applying his compasses, that the whole breadth of the propellers is fully four times the throw of the crank, or, "12 feet broad, if the cranks are 3 feet," and 8 feet 6 inches, if the cranks are 2 feet.

I made a mistake in stating the breadth of 24 feet, as being necessary for a propeller large enough to

produce the same effect as the Dundee boat's wheel; I should have said 18 feet, and this is the inventor's own proportions. Two projections, one on each side and 18 feet broad, each in the shape of heavy, complex, and rapid working machinery, would certainly be *very safe and convenient appendages* at sea, or in a river!

It seems, however, that the machine is fitted up, and one weighing a ton with twelve working journals, "and dipping into the water, twenty revolutions in a minute can be driven by one hand, (is it a man's hand?) with a crank of 20 inches throw!!! and not a crank has yet broken." There is very little fear of their breaking either, with such a power and such a speed, if there is a ton of material in them. I should like to know, what is the use of the friends of this scheme defending it by mere words, when they have it in their power to exhibit it, and its performances to the public, and thereby silence all scepticism at once: until this is done, we are not bound to take *any* opinion upon its merits. But I venture to prophecy, that it will never be publicly applied, and that it will sink into oblivion, like the hundred other *improved* paddles, that have preceded it; simply because it will not do nearly so well as the common wheel.

I have to apologise to you, Mr. Editor, and to your readers, for occupying so much of your space, with so trifling a subject. I do so, because I consider it a duty every subscriber owes to himself, to do his best to drive out frivolous matter from a work which seems to have no lack of original and interesting matter at its command; a work, too, which no mechanical man can do without.

I am, Sir,

D. LANDALE.

Wemyss Cottage, June 8, 1835.

P. S.—Since I wrote the last article on Mr. M'Curdy's propellers, I have been informed by a gentleman, well acquainted with the Dundee steam-boats, that there are more than eighteen arms in the wheels; consequently, this tells so much the more against the propeller. But I have made no use of this in the preceding remarks, as I wish to sustain my first objections. D. L.

ON RAILWAYS. BY JOHN HERAPATH, ESQ.

NO. IV.

Southern Railways.

Among the railways to the south, three designs to Brighton have already made their appearance; one by Messrs. Rennie, a second by Mr. Vignoles, and a third by Mr. Cundy. The respective working merits of the first and last of these schemes I propose, in the present Number, to examine; but the second I shall be obliged to defer, on account of the very discrepant nature of the information I have received from three gentlemen respecting it.

Messrs. Rennie's line was designed to commence at Kennington Common, and proceed to Streatham, $4\frac{1}{4}$ miles, rising $24\frac{1}{2}$ feet per mile. Leaving Croydon on the east it proceeds for $6\frac{1}{4}$ miles, ascending at the rate of 21 feet per mile to near the lime-works. For half a mile further it sinks 27 feet, or 54 feet per mile; and then rises again $27\frac{1}{2}$ feet per mile, until it reaches Merstham, $4\frac{1}{2}$ miles further. Thence to the river Mole $4\frac{1}{2}$ miles it descends $38\frac{1}{4}$ feet in the mile, and again looks up for $9\frac{1}{2}$ miles to Balcom Downs, $23\frac{3}{4}$ feet per mile. This is the highest point in the line, being 395 feet above the Trinity tide level. From this point is a descent of $35\frac{1}{4}$ feet in the mile for $5\frac{1}{2}$ miles; afterwards a level 10 miles further to Patcham; and then a descent to Preston and Brighton 2 miles beyond, at a rate, I think, of about 50 feet per mile; but the statements I have do not clearly show the proportion. According to this line the distance to Brighton would be 47 miles.

It will be seen from the preceding account, that Messrs. Rennie's line is on the undulating principle; and if executed would have presented a fine opportunity to Mr. Badnall with which to try the merits of undulating railways.

No less than five tunnels ornament this line from London to Brighton, with a sixth between Brighton and Shoreham. One would suppose that Messrs. Rennie were much enamoured of tunnels to propose five, aggregating 7 miles of groping in darkness, in only 47 miles of railway. They are arranged also in a peculiar manner. Beginning with a tunnel of a mile near the lime-works, they increase in length, perhaps to instruct Londoners gradually in tunnel-travelling, until the last at Patcham extends $2\frac{1}{4}$ miles. As if too for the purpose of

playing with passengers' feelings, the end of a train would be scarcely emerged from the first tunnel before its beginning would be plunged into the second; and long before the unfortunate travellers, leaving the second, had recovered sufficiently to look broad day in the face, they would be immersed in the third. To aeronauts this popping in and popping out of tunnels would appear like children playing at bo-peep. From the third tunnel a plane falls 38 feet per mile across the river Mole, at an elevation of about 100 feet above it. Let us for a moment stop to contemplate this point of the project. Here would travellers in one minute be traversing in darkness the bowels of a lofty hill, nearly suffocated with smoke, steam, and coke, amidst springs dripping on all sides from above—in the next minute skimming, in the full glare of day, at a terrific velocity, a narrow ledge, raised some hundred feet in the air, with threatening precipices on each side, and a river ready to receive them beneath. Let us, I say, for a moment, picture to ourselves such a scene, and ask which of us would have nerve enough to try it? If beauty consists in contrast and variety, Messrs. Rennie have catered well for the public. That they are men of lofty notions no one can doubt—the very hills they attack, 4 or 5 or 600 feet high, are a proof of it—but where would they find passengers to encounter this railroad of extremes and contrarieties? Not in London or elsewhere, I think, after one experience of its comforts.

Among all the singular qualities of this project, that of combining the greatest nuisance with the greatest evil, that is, a tunnel with a steep inclined plane; and not only of combining them, but of making conflicting inclined planes, that is, rising and falling planes within the same tunnel, is the most extraordinary. Whatever could have induced the projectors to propose a tunnel, ascending and descending by 1 in 107, as I am informed they have in the Merstham tunnel, I cannot conceive, unless to let off the water of the springs they expected to tap, or to insure greater facility in escaping apprehended dangers within. But were one to follow out all the peculiarities of this line, it would be concluded that it was never intended for real and sober practice, but to create subjects for a new species of novel writing.

However, I have heard it has been set at rest, and therefore I shall finish my observations with computations of its time of transit, with the velocity and expense of transporting a ton of goods on it (according to the table in my last) from London to Brighton. With regard to the descending planes, it is difficult to estimate either expense or velocity. In any of the four on this line, trains must be checked by the breaks. Therefore, and as the fire must be kept up for ascending the following planes, though the steam be turned off, it would not be much out of the way, probably, to reckon the expense at a farthing per ton per mile, or one-half that on a level. We may likewise safely set the descending velocities at 30 miles per hour; for in descending the Manchester and Liverpool inclined planes, 24 miles an hour is, I am informed, considered enough for safety, and the men are fined if they allow the trains to go faster.

Expense per ton per mile, with the velocity and time of transit of a load on Messrs. Rennie's Brighton line, corresponding to the several miles in the first column:—

Miles.	Expense.	Velocity.	Time.
	d.	*Miles.*	*Minutes.*
4¼	4·45	14·5	17·6
6¼	6·13	15·3	24·5
½	0·12	30·0	1·0
4½	5·08	13·3	20·3
4½	1·12	30·0	9·0
9½	9·87	14·4	39·6
5½	1·37	30·0	11·0
10	5·00	30·0	20·0
2	0·50	30·0	4·0
47	33·64		147·0

This line, therefore, would convey goods for 2*s.* 10*d.* per ton, in 2 hours 27 minutes from London to Brighton; but if worked with one engine it could only take $\frac{44}{100}$ths of a load. In the return to London the line would be more difficult, and one engine would only take about $\frac{37}{100}$ths of a load.

Mr. Vignoles's Line.

Though Mr. Vignoles appears to be less ambitious of soaring among the clouds, by keeping 50 feet lower than Messrs. Rennie, yet his line presents a more difficult one to work, especially in the return, than theirs, and has all the objections of four tunnels and lofty em-

bankments. However, not having confidence in the accounts I have of it, I fear to hazard a decided opinion, least I should do it injustice. His line is 54½ miles to Brighton, through Shoreham.

Mr. Cundy's Line.

More humble, I suppose, in his views, or thinking with us that low levels and easy planes are preferable for locomotive power, Mr. Cundy has contrived to find a line 100 feet lower than Mr. Vignoles, and 150 lower than Messrs. Rennie; and, what is more remarkable, with a mile less in distance than Mr. Vignoles, he keeps clear of those nuisances tunnels, has inferior cuttings and embankments, and fewer difficulties than either.

Mr. Cundy starts from St. George's Fields; reaches Streatham Common 3¼ miles, at a rise of 13 feet per mile; descends 2½ miles more, 11⅕ feet per mile, to Mitcham Church; ascends 4 miles to the Nelson, at 10⅔ feet per mile; then 3¾ miles to Epsom Common, at 16⅘ feet per mile; and 3 miles farther to Leatherhead, at 6⅓ feet per mile. From this place he drops 3 miles to the river Mole, with 3⅜ feet per mile; then rises for 7¾ miles, in 12 feet per mile, to the summit of his line, 250 feet above tide level. He now descends to Nuthurst Lodge 7¾ miles, at 13⅕ feet per mile; then in 7¼ miles to West End 15$\frac{3}{10}$ feet per mile; and arrives at Old Shoreham, 7 miles farther, with only 1 foot per mile descent. From Shoreham he goes to Brighton, 4¼ miles, rising 1 foot per mile.

Such is the extract of this line, which I have made from a copy of the plan sent to the Clerk of the Peace. We shall now, on the same principles as before, give a table of its velocity and time of transit, and the expense per mile of carrying a ton of goods:—

Miles.	Expense.	Velocity per hour.	Time of Transit.
	d.	*Miles.*	*m.*
3¼	2·62	18·9	10·5
2½	·62	30·0	5·0
4	2·97	20·3	11·8
3¾	3.25	17·0	13·2
3	1·92	23·5	7·7
3	1·30	30·0	6 0
7¾	5·97	19·5	23·9
7¾	1·94	30·0	15·5
7¼	1·82	30 0	14·5
7	3·50	30·0	14·0
4¼	3·50	28·8	8·0
53½	29·41		131·0

The expense, therefore, of transporting a ton of goods from London to Brighton, by Old Shoreham, 53½ miles, is 2*s.* 5½*d.*; and the time in which a single engine, whose maximum effort on a level is 30 miles per hour, would take to convey a load, would be $2^h\,11^m$. The load, too, which the engine could take would be $\frac{57}{100}$ths of its full load on a level. In the contrary direction the line would work somewhat easier.

This, then, is the mercantile position of the two lines. Messrs. Rennie's easiest plane is 21 feet per mile, Mr. Cundy's most difficult 16⅘; Messrs. Rennie's favourable maximum weight is $\frac{44}{100}$ths of a full load, Mr. Cundy's about $\frac{60}{100}$ths, or nearly 50 per cent. more; the former's unfavourable maximum weight is $\frac{37}{100}$ths, the latter's $\frac{57}{100}$ths, or 54 per cent. more. That is, for every 100 tons Rennies' line could carry without assisting engines, Cundy's could carry at an average 152; and, were the engines doing their best all the way, at nearly the same expense, Rennies' distance is only 47 miles, Cundy's 53½, yet the expense of transport on the short distance is 2*s.* 10*d.*, on the long but 2*s.* 5½*d.*, or 13 per cent. less; and the time for the 47 miles is $2^h\,27^m$, for the 53½ miles only $2^h\,11^m$.

Our readers will here perceive that these computations, which, I believe, are pretty correctly made, depend on the accuracy of the statements of the respective engineers. Hints have been given to me that there are errors in both lines, which may be the case; but they must be enormous, to reduce one line to a parallel with the other. The probability certainly is, that whatever errors exist are one way in both. I have, indeed, seen persons who know the ground of both lines, and they have uniformly given an unqualified preference to Mr. Cundy's. However, the advantages appear to be so strong in favour of Mr. Cundy's plan, his line so good, so free from sharp curves, tunnel nuisances, &c., and so singularly well-adapted for locomotive power, that I confess, before I entirely subscribe to its accuracy, I should like to make a personal survey of it; and had I any interest in it I certainly would.

Some may here remark that, notwithstanding what I have shown, I have not done Mr. Cundy's line the same justice that I have Messrs. Rennie's, inasmuch as I have confined its maximum velocity

to 30 miles an hour, the same as on Messrs. Rennie's, whereas it is obvious that much greater velocities may be maintained with equal safety on lines descending easily, than on those descending abruptly; and, therefore, it may be contended that Mr. Cundy's time of transit might fairly be brought within two hours. To this, and other charges of the kind, I plead guilty; and I will even go so far as to admit, that, as I fully expect locomotive engines will ere long be brought to travel 50 miles an hour as easily as they now do 30, I should not be surprised to hear of an equal distance on such a line being traversed in an hour; I think, with a light load, it now could in $1\frac{1}{4}$ hour.

JOHN HERAPATH.

Kensington, June, 1835.

BIDDER'S TABLE FOR THE CALCULATION OF EARTH-WORK.*

The name of *Bidder* is so identified with extraordinary powers of *calculation*, as instantly to bespeak great confidence in any production of the press, of which *calculation* is the object. Nor will any expectation which the name of Bidder may excite in the present instance, be in the least disappointed. The celebrated "calculating boy" now makes his bow as one of the profession of Civil Engineers, with a table in hand, which presents striking evidence of the practical usefulness of that peculiar—indeed inexplicable—faculty, which has given early distinction to his name. Mr. Bidder has not, like Mr. Macneill, required a large and expensive volume to instruct engineers how to estimate the cuttings and embankments necessary for any particular work, or excavators, how to check the pay-lists of their employers; but, *like himself*, he has presented on the face of a single sheet, the whole process (if not the *rationale*) of calculating qualities of earth-work, of all degrees of magnitude. Mr. Macneill's is by no means a bad work—a much better one, indeed, than some correspondents of ours have shown themselves disposed to admit;† but it does no more than this single sheet of Mr. Bidder's does, at 1-15th of the expense, and in some 500th part of the space. The great difficulty in calculations of this sort, is occasioned by the form of the slopes, when the heights at the opposite ends of cuttings or embankments are *unequal*. Mr. Macneill, in his tables, cumulates the contents of the slopes, with those of the central or parallel portion of the cutting or embankment; and hence the inconvenient size for reference, to which his volume has extended. His quantities, besides, are computed to a length of one foot, whereas the scales of engineers and excavators are commonly made to chain lengths, and the sections drawn to the same—the original measurements being taken by the chain; so that when Mr. Macneill's tables are used, it requires an extra operation to reduce the quantities to the foot measure, and by means too of decimals (in which, we regret to say, there is usually more *Hebrew* than is either Christian-like or engineer-like). Mr. Bidder's table is quite free from the former of these objections, and in a great measure from the latter; for, in the first place, it is, as before stated, all contained on the face of a single sheet; and, second, it is computed according to the chain length, which not only corresponds with the scales in general use, but is more easily reducible to the foot measure, than the foot measure is reducible to the chain. Mr. Bidder's sheet does not give the formula which he has followed in his calculations; but we have been favoured by him with an impression of the master-key made use of, which we subjoin.

$$\frac{22}{27}\left[(a+b)^2 - a\,b\right]$$

$$\frac{11}{9}\,(a+b)$$

* A Table showing the Contents of Excavations intended to Facilitate the Estimating of Public Works By George P. Bidder, C. E. London: S. Maynard.

† We may take this opportunity of expressing our regret, that the terms in which we have frequently felt obliged of speak to Mr. Macneill, should have given so much offence to certain respectable friends of his and ours at Belfast. We subscribe to all they say about Mr. Macneill's practical skill (wherever it has been *practically* exhibited), and are very willing to believe all they tell us about his good-fellow qualities; but when any person, no matter how skilful or how eminent, gravely propounds in print such follies as that of making thousand-ton ships skim the deep without any displacement of the liquid element, or going by canal from London to Birmingham in six hours, in spite of locks, which would, of themselves, occupy more than all the time—how can one help laughing? Or say rather, "who would not weep if Atticus were he."

SELF-SUPPORTING SUSPENSION BRIDGES.

Sir,—The mechanical world is under considerable obligation to you, for exposing schemes and their authors, when they are based in knavery, and also for recording the results of experiments without reference to the motives of the authors or inventors; but there are times, sir, when in your zeal you exceed yourself, if the expression is admissible. In your Number, 615, May 23, is a notice of a new suspension-bridge, wherein you ridicule the Frenchman's idea of self-support. I admit the description is obscure; but as it answers precisely to a conception of mine for erecting a bridge over the Estuary, at Lynn Regis, I can comprehend the whole of it, and I pledge myself to produce an unexceptionable bridge, without deviating from the description you have copied from the "Athenæum." The reason why the English bridges stand, is because greater attention is paid to render every part consistent in strength with the other, so as to produce uniform strength in the mass. So far from being disposed to ridicule new plans, I, for one, feel satisfied we shall have many, until one is developed embracing both the pendant and insistent principle in the same arch; but I do not anticipate that the span of the Menai will ever be much exceeded. The steam ferry boat has upset all projects for larger or rather greater spans in England. I am aware of Mr. Leather's plan of a bridge over the Aire, in Yorkshire; but that does not come up to my idea of combining the two systems.

I am, Sir, yours truly,

W. THOROLD.

Norwich, May 25, 1835.

INFERIOR QUALITY OF HOT-AIR SMELTED IRON.

Sir,—At p. 143, vol. xvii., you quote from the "Athenæum," a statement made at a meeting of the Society of Civil Engineers, to the effect, that, at the Clyde Iron-works, the hot blast has been in use since 1829, and the result has been the reduction of the proportion of coal for the manufacture of one ton of pig iron from 8 to 5 tons.

Again, at p. 272; the weekly consumption of coals at the Clyde Iron-works is said to have been reduced, by the adoption of heated blast, from 1800 to 600 tons; while, at the same time, a greater quantity of iron has been manufactured.

And in an editorial note (p. 312, vol. xx.) to a notice of the German translation of Babbage's Economy of Machinery, &c., you speak to the unquestionable fact. that, at the Clyde Iron-works, a saving has been effected, by the use of the hot-air blast, of between 30 and 40 per cent.

This is all one way; and, as far as it goes, there is no doubt it is perfectly right: indeed, as relates to economy, the fact is fully borne out by the present extensive use of the hot blast. But should not the Society of Civil Engineers have carried their labours somewhat further? Would it not have been worthy of so scientific a body of the profession to have inquired into the nature and properties of the metal so manufactured? In fact, any one would imagine that such was their immediate and particular province: but, as nothing has yet transpired on that head,—at least as far as my knowledge extends,—I am led to suppose that their labours ceased with pointing out the pecuniary advantages that would accrue to the iron-master, leaving the consumer to find out, by sad experience, how much the quality of the metal is deteriorated by the new process.

Iron-founders, particularly those who have much light work, are induced to purchase, not by any reduction in price (notwithstanding the great saving as above quoted), but by the iron thus manufactured being represented as particularly soft, and running very fluid. Both statements are certainly true; but, at the same time, the castings rarely carry so good a face, and the metal is so tender as not to bear contraction, but frequently breaks in cooling; and light castings when broken have, both in grain and colour, so much the appearance of burnt iron, that the one has been mistaken for the other by experienced workmen. Whether this arises from an excess of carbon, or an excess of sulphur, from the use of green coal, or from a combination of causes. I am not competent to say, but I am satisfied of the fact. As a further proof, I tried a bar four feet long, and one inch square, which broke with 7 Ilbs

less than is given (in a work I have on the subject) for the weakest bar. I then, at the suggestion of a friend (who thought my experiment not sufficiently conclusive), procured a bar two feet long, that had been cast at least 16 or 18 years; and, not having the means of accurately measuring the deflection, I proceeded as before, and loaded it till it broke: but a similar bar of coal-iron broke with 84 lbs less weight. Another fact worthy of notice is, that the contraction is much more than usual; amounting, in several instances that have come under my notice, to $\frac{3}{16}$ of an inch to a foot.

Yours respectfully,

TREBOR VALENTINE.

REMARKS ON THE SUBSTITUTION OF LOCKS FOR INCLINED PLANES ON RAILWAYS.

[From the American Railroad Journal.]

The disuse of stationary steam power on railways has long been an object whose attainment has been anxiously desired, but hardly expected. Attention to this subject is daily increasing, as its importance is continually growing more apparent.

The efforts of ingenuity have heretofore been generally directed to improvements in the locomotive engine, by which it would be enabled to move up very considerable ascents by its own unassisted strength. In a late number of the Railroad Journal, I find an extract from a Baltimore paper, stating that an engine had been fabricated in that city able to rise on an elevation of two hundred and sixty feet in a mile, or one foot in twenty; and the belief is expressed, that the same species of engine would be capable of carrying one hundred passengers in a train of cars, up an acclivity of one hundred feet in a mile, at the rate of ten miles an hour.

This may perhaps be all accomplished, but still I have doubts as to the substantial utility of such an achievement. For the attainment of the greatest degree of economy, all the power of the engine, which may be safely exerted, should be constantly employed. But if sufficient energy is provided to rise such steep acclivities, there must be an immense superabundance and waste throughout all the other portions of the route.

In a report of the commissioners of the Liverpool and Manchester Railway, made to the House of Commons a few years since, it is stated, as the result of experiment, that an engine capable of moving thirty tons over a level track could raise no more than seven tons on an elevation of one foot in a hundred, or about fifty-two in a mile If this be true, the same engine would be unable to draw more than three tons at the utmost, where the ascent was a hundred feet in a mile, since the load capable of being propelled would have to be diminished much faster than in a direct proportion to the degree of acclivity; and since the engine and its appurtenances occasion almost the sole expense of transportation, the cost of carrying three tons over such an undulating road would be nearly equal to the freight on thirty tons upon a level way. The whole load which an engine can transport will be limited by what it can move over the most difficult part of the way. Now, I do not doubt but that engines may be constructed capable of raising a load on an elevation of one hundred feet in a mile; but would it not be wiser to construct the road more nearly level, so that the same engine might carry a load several times as large? Where the transportation of passengers is alone concerned, economy being of little consequence in comparison with speed, such a waste of power may be justified; but where intended principally for the carriage of freight—where the diminution of expense is the principal object, there are very strong objections to an arrangement by which a large proportion of the propelling power lies waste and idle during the greater part of the journey, to be exerted only on the ascent of eminences.

In England, where there is much more experience than in this country, not only in the construction, but also in the operation of railroads, it is considered unwise to attempt the ascents of more than fifty feet in a mile by the sole power of the locomotive.

But it is not merely a want of power which fixes a limit to the degree of ascent practicable on railways. No matter what the ability of the engine, if the adhesion of the wheels to the rail is not sufficient to prevent them from sliding round in their places, the load cannot be moved; and this it is which, more than any thing else, renders rapid ascents impracticable. Experiments made when the wheels and rails are new, and not yet worn smooth by use, are not satisfactory upon this point, especially when it is recollected that those rails may not unfrequently be rendered slippery by ice or snow. The importance, therefore, of resorting to some other substitute for inclined planes, besides those hitherto contrived, is sufficiently evident.

An expedient of such a nature has lately received some notice, not only in the columns of this Journal, but also in those of several other public prints. I refer to the railroad lock invented by Colonel Taylor. An attentive examination will, I think, convince

any one, that its operation is founded upon well-established principles of mechanical philosophy, and that it must prove successful.

The great object of the lock in question is to enable the locomotive engine to raise itself and all its train by its own unassisted strength, over any elevation, no matter how high, or how steep. This object is attained by a recourse to that universal mechanical principle, that what a power wants in intensity, may be made up for in distance; that if it is only the half of what would be required to move a given weight on a direct application, such machinery must be interposed as that the distance through which the power moves may be twice as great as that through which the weight is raised. The merit of the invention in question consists in this: that when an ascent is to be overcome, and the power ordinarily required becomes insufficient, a provision is made by which the distance traversed by it may be any number of times greater than that ascended by the weight, so that no additional force is called for to assist the locomotive in any emergency.

This is accomplished by the agency of screws, which being moved by the power of the locomotive itself, elevate the engine and all its train perpendicularly from one reach to another. It will be readily perceived that such machinery may be interposed between the power and the load, that the distance traversed by the former, that is to say, the space through which the piston moves, shall bear any necessary proportion to that ascended by the latter, and thus success be rendered certain.

As has been already observed, the great object to be attained in order to secure the strictest economy in transportation, is such an arrangement that the power required to propel the load may be the same throughout every portion of the route. Now, suppose the road to be perfectly horizontal, and all changes of level between one reach and another to be effected by the locks in question; and suppose the machinery of those locks to be so constructed and proportioned that the same power which propels the load upon the rails should be just sufficient to raise it upon the locks, the object desired is completely attained. Not one ounce of power would lie idle throughout any portion of the route —not an ounce would be wanting. There would be neither loss nor deficiency; and the system, so far as economy of transportation was concerned, would be perfect.

Such a state of exactness would not, however, be necessary or advisable. The increased expense of grading would more than counterbalance the advantage to be gained from a perfectly level road. The power of a steam-engine is not fixed and invariable. It may, to a certain extent, be increased, without detriment, so as to enable it to rise over moderate elevations. Still it is sufficiently evident, that although it may not be practicable to carry the proposed system to a degree of absolute perfection, yet that state may, without difficulty, be so nearly approached as to secure the greatest advantages.

I have at this time paid no regard to the superior excellence of the lock in question, so far as safety, convenience, and economy of construction were concerned. This might be readily shown, and in many respects will be at once perceived, without further explanation. There is every probability, therefore, that success will crown this endeavour to improve the construction of railways, and will, I trust, become an important era in thehistory of internal improvements.

M.

THE PNEUMATIC RAILWAY—A THIRD CLAIMANT.

Sir,—I perceive that in a late number of your valuable and interesting journal, a new claimant has appeared to the invention of the Pneumatic Railway. The honour, however, belongs neither to Mr Pinkus, nor Mr. Wrigg, nor even Mr. Vallance; for, in the year 1812, a Mr. Midhurst, of Denmark-street, Soho, put forth a prospectus (from which I send you an extract), for a *tubular scheme* for conveying goods and passengers with safety, speed, and cheapness; which scheme your readers will find embraces all the material features of the more recent projects.

I am, Sir, &c.

R. Roffe.

The great velocity of air through an aperture or tube (says the inventor) has been but little noticed: it may be proved that air will pass through a tube with a velocity of 200 feet in a second, by a pressure of 134 lb. per square foot; and 73 feet in a second, or 50 miles per hour, by a pressure of 250 oz. per square foot. To apply this principle to the conveying of goods and passengers from place to place, a hollow tube or archway must be constructed the whole distance, of iron, brick, timber, or any material that will confine the air, and of such dimensions as to admit a four-wheeled carriage to run through it. The tube must be made

air-tight, and of the same form and dimensions throughout, having a pair of cast iron wheel-tracks securely laid all along the bottom, for the wheels of the carriage to run upon; and the carriage must be nearly of the size and form of the tube, so as to prevent any considerable quantity of air from passing by it. If the air is forced into the mouth of the tube behind the carriage, it will be driven forward by the pressure of the air against it: and, as the air will be continually driven into the tube, the pressure against the carriage, and consequently its motion, will be continually maintained through the whole length. If the tube is six feet high inside, it will admit of the carriage-wheels to be five feet ten inches in diameter; which must turn four times round in a second to go 50 miles per hour. The impelling power must be equal to 861 lb.; and the quantity of air driven into the tube, to move 50 miles per hour, will be 2,200 cubic feet per second. An impelling power of 861 lb., moving 73 feet per second, is equal to the continual power of 180 horses, and will be maintained by a steam-engine, consuming twelve bushels of coals per hour; and, therefore, three tons weight of goods will be conveyed 50 miles for 12 shillings. In many cases it will be practicable, upon the same principle, to form a tube, so as to leave a continual communication between the inside and the outside of it, without suffering any part of the impelling air to escape; and by this means impel a carriage along upon an iron road in the open air, with equal velocity, and in a great degree possessing the same advantages as in passing inside the tube.

Where carriages are continually passing both ways at the same time, the same body of air that impels them one way, may be applied again to impel them the other. The expenses, a double tube for internal conveyance, of these dimensions, constructed with English timber, together with the iron roads within them, and all costs attending it, would amount to 7,000*l.* per mile. The carriage of 700 ton of goods and passengers per day, each way, with a profit to the proprietor of twopence per ton, per mile, will amount to 4,256*l.* per annum, per mile. The principal advantage attending this mode of conveyance will be—First, passengers may be conveyed to the greatest distance through the country with ease and great safety, at the rate of a mile in a minute, or fifty miles per hour upon an average, and at an expense of one farthing per mile. Second—ditto, goods at the expense of one penny per ton, per mile, conveyance. Third, the conveyance cannot be obstructed or impeded by frosts, snows, floods, or drought, nor endangered by darkness or the weather. Live cattle will be enabled to pass through the country without labour, and at a very small expense for carriage or for food. Fish may be brought from the coast in a perfect state; and all perishable goods may be brought to market from their native soil, and in their native purity; and the mails may be conveyed at a very small expense; for the weight of two hundred thousand letters will not exceed one ton, and they may be delivered twice a day at 400 miles distance.

PUBLIC WATER-WORKS.

Mr. Matthews, who is already known to the public as the author of a very good History of Gas-lighting, has again signalised his love of useful research by a similar work on water supplying. Of his "Hydraulia; or, History of the Water-Works of London and other Great Cities,"* we may say, what cannot with equal truth be said of many of the scientific compilations of the day, that it supplies a positive want in the literature of the country. For, notwithstanding the great importance of a perfect acquaintance with the means adopted in different ages and countries, to furnish a plentiful supply of good water to the immense masses of human beings so frequently congregated together in urban localities, and though the people of Great Britain probably enjoy greater advantages in this respect than any other people on the face of the earth; yet, as Mr. Matthews correctly states, no work devoted to the subject of public water-works, has "heretofore appeared,

* Hydraulia. An Historical and Descriptive Account of the Water-Works of London, and the Contrivances for supplying other Great Cities in different Ages and Countries. By William Matthews. Pp. 454. 8vo. 1835. Simpkin and Co.

in our language;" and "but comparatively few persons have (more than) a slight degree of knowledge of the ingenious means employed to afford such advantages."

Mr. Matthews's "Hydraulia" is divided into twenty-one chapters; twelve of which are engrossed by the rise and progress of the several metropolitan and provincial water-works of Great Britain: one treats of Paris, another of Constantinople; five are occupied by the Fountains, Aqueducts, and Baths, of the Egyptians, Greeks, Romans, and other nations of ancient times; and two embrace the general topics belonging to the subject, such as lifting, forcing, filtration, &c.

The large space assigned to the water-works of Great Britain, in this arrangement, has an ample warranty in their preeminent importance. Not only are they unequalled among the modern works of this class, but unrivalled by the best of which antiquity could boast. Mr. Matthews has presented us, in the following passage, with a lively contrast between the public works of warlike Rome and commercial Britain; but justice to his subject required that he should have given to the water-works of the latter a much more prominent place in the picture.

"Considerations of economy may have precluded much display of external magnificence in the execution of some public works; nevertheless, the rapid and striking progress of both the fine and the useful arts, during the last century, affords abundant evidence of the encouragement bestowed upon them, as well as the prevalence of refined taste, enlightened views, and liberal sentiments. Notwithstanding some persons have strenuously maintained that commercial occupations inevitably tend to contract the mind, by generating a sordid disposition; yet the noble and superb structures now adorning London, Liverpool, Edinburgh, and many other places, may be adduced as instances to vie with some of those which formerly embellished Imperial Rome. The docks, canals, railroads, bridges, arsenals, and other works constructed during a comparatively recent period, and conspicuous alike for utility and magnitude, surpass many of the boldest productions of that much celebrated era. Indeed, if it were possible for an old Roman to rise from the grave, to contemplate the extent of our navies and commerce; the amazing power and diversified applications of the steam-engine; the wide diffusion and brilliance of our gas-lights; the number of our large founderies and manufactories, with the infinite variety of contrivances which not only distinguish every branch of art, but are likewise made subservient to the various wants, enjoyments, and conveniences of social life, he might be disposed to conclude that he actually lived in the infancy of the world, proudly as he once vaunted of his superiority over the mass of mankind."—p. 215.

The amount of capital embarked in the different water-works of Great Britain is estimated by Mr. Matthews to amount to not less than twenty millions! The whole of this immense sum—with the exception of a few thousands which James I. lent Sir Hugh Myddelton to complete the New River works—has been spontaneously furnished by individuals, or by associations of individuals. The works, though public, have all sprung out of private speculation and enterprise. They are parts of that system of self-dependence and government, for which the people of Great Britain are so happily distinguished amongst the nations. The public works of other countries can be said to illustrate only the personal characters of those who dwell in their high places, and are but too often melancholy memorials of surrounding thraldom and degradation; but those of Great Britain do really and truly attest the genius of the entire people—a people who owe nearly all that they possess of freedom or of greatness to themselves alone.

The progress made in the supply of water to London, from the time when it depended on the wells in its immediate vicinity, till recourse was had to the waters of the Thames and Lea, is traced and described by Mr. Matthews with great, but not unedifying minuteness. The inadequacy of the springs of the London basin to supply the wants of its inhabitants, becomes, at every step of this retrospect, strikingly manifest. Constantly were the citizens on the search after springs; and as constantly did the public demand, outstrip all the supply that could be obtained from this source: no sooner was an abundant spring opened in one quarter, than a failure of the springs in some other was experienced. From the suburbs the sphere of operations was gradually extended, till it embraced the whole country round for many miles. At first they had at the gates of the city, Holy Well, Clerk's Well, and St. Clement's Well; then

water was brought from wells at Highbury, Tyburn, and Paddington; next from Hampstead Heath, Marylebone, Hackney, and Muswell Hill. The difficulty of conducting it from any greater distance, or else the great expense, compelled them at last to have recourse to the Thames, which from the prejudice in favour of spring-water, then, as now, so generally entertained, had hitherto been but little resorted to for domestic purposes. The citizens of London were indebted to the ingenuity of a Dutchman, named Peter Morrice, for the first effort made on a large scale to supply them with water from the Thames:—

"All the contrivances of the Romans, as well as those heretofore adopted for supplying London, had been formed upon that well-known principle, that water will flow by its natural gravity along any channel that has the slightest inclination downwards. But the purpose of Morrice's machinery was to impel the water in an ascending direction, and thus supply places higher than its usual level. His *throwing water over St. Magnus' steeple* must naturally have excited wonder; and although no particular description was given of the means he employed to effect the object, it will be obvious that the use of the forcing pump accomplished it."—p. 27.

This is probably the first instance in which any great quantity of water was ever supplied to a city by such means; and it speaks much for the skill shown by Morrice in the construction of the works, that they are supposed to have been nearly in the same state, as far as regards the general arrangement, when finally removed on the recent demolition of old London bridge, as when first constructed, more than two centuries ago.

The information which Mr. Matthews has been able to collect on the subject of these works is unfortunately very scanty; consisting chiefly of an abridgment (a very good one, however,) of a description of them by Mr. Beighton, the well-known engineer, which appeared in the *Philosophical Transactions*, for 1731. The motive power in these works, as most of our readers are no doubt aware, was obtained from the rise and fall of the tides; but at times, when the tides were low, it was necessary to have the aid of a steam-engine to pump water from a point near to the middle of the river. When Beighton wrote, there were only three wheels, which raised 1954 hogsheads of water per hour. But the number was subsequently increased to six; and in 1821 the average quantity of water daily supplied was estimated to amount to nearly 4,000,000 of gallons. All the wheels were originally of wood; but, in 1807, an iron wheel of great magnitude was substituted for one of them, at an expense of 6,500*l.*, and afterwards another, which cost 5,000*l.* In 1821, the number of houses supplied by them was 10,417, and the quantity of water annually 26,322,705 hogsheads.

The scheme of Sir Hugh Myddelton, for bringing a supply from Amwell and Chadwell, by what has obtained the name of the New River—stupendous as it was, and great as were the difficulties to be overcome in its execution—must be considered rather as a retrograde movement in hydraulic science. It was a return to the old plan of taking the supply from a source above the level of the place where it was wanted. There was even less scientific knowledge shown in its construction, than was evinced by the unscientific Turks, in their manner of conducting water over valleys. The Englishman led his New River over valleys in large wooden troughs, lined with lead, while the Turks availed themselves of the syphon in their *souterazi*.

So indispensable, indeed, seem to have been inclined planes in the execution of the New River, that the windings made in its course, to obtain them, are quite fantastical. In a direct line, from point to point, it is not above twenty miles in length, yet, by its sinuosities, its extent is nearly doubled; for, "from an exact admeasurement, made in 1723 by Mr. Henry Mills, the engineer and surveyor of the New River Company, its extent was ascertained to be 38¾ miles and 16 poles." It might certainly be more appropriately denominated the "Serpentine River," than the straight piece of water known by that name in Hyde-park. The adoption of this meandering course could not have arisen from any design of checking the force of the current, and causing it to flow gently, for the inclination is only three inches in a mile. "Public-spirited," "ingenious" and "magnanimous," therefore, as "Master Hugh Myddelton" was—the greatest benefactor assuredly, whom the metropolis ever possessed—his claims to rank as a man of science cannot be considered as of a very high order.

The story which has been so long current of Myddelton's having been reduced, by the execution of this vast project, to a state of beggary, and dying in it, is shown by Mr. Matthews to be, in all probability, quite unfounded.

"The perusal of Sir Hugh Myddelton's will has a tendency to prove the incorrectness of some of the statements commonly made by his biographers concerning his indigence, after the completion of the New River, as well as the place of his birth. The latter is ascertained by his bequest of '20*l.* to the poor of Henlan, in the county of Denbigh, where he was born.' That he materially diminished the amount of his wealth by attempting to construct the New River at his own expense, must be acknowledged; nevertheless, at the time of his decease, he possessed about twenty shares in the concern, besides other property of various kinds; for to his wife he bequeathed thirteen shares, his house at Bush-hill, Edmonton, with all the furniture, plate, jewels, &c., and to descend to his younger son Simon after her death. He had four sons and three daughters; and to two of the latter he bequeathed each a share, accompanied by legacies of 300*l.*; to three of his sons also each a share, attaching to one a legacy of 400*l.*, to another a legacy of only 100*l.*, 'having given him his share during his life.' To one daughter, who 'had her full portion on her marriage,' he gave only 10*l.*, to buy rings for her and her husband; but to a younger he left 1000*l.*, with an additional 900*l.* on the performance of certain conditions by her husband's relations, because he was not of age. Nearly twenty legacies were left to others, varying in their sums from 50*l.* to 5*l.*; but the greater number consisted of 30*l.* and 20*l.*, besides 5*l.* each to every one of his servants, excepting two, who had only 40*s.* To these bequests may be added the 'one share in the New River to the Goldsmith's Company in trust, the profit to be distributed every half-year, after the death of his wife, in weekly portions of twelve pence each, to the poor of the said company, by the discretion of the warden for the time being, and in preference to the poor of his own name, kindred, and country.' He likewise possessed 'shares in the Mines Royal, in Wales,' which he directed 'to be sold to pay his debts;' and 'if they did not prove sufficient, then some of the shares, or parts of shares, in the New River, to be sold to make good the deficiency.' The date of this will is Nov. 21, 1631; but he did not die till 1636, and all that time the income of the New River property was greatly improving; for although, in 1633, the dividend on each share amounted merely to 3*l.* 4*s.* 2*d.*; yet, in 1640, it had risen to 33*l.* 2*s.* 8*d.*; and in 1680 had increased to 145*l.* 1*s.* 8*d.* Hence these facts may perhaps justify a conclusion that Sir Hugh Myddelton did not die in very indigent circumstances, whatever misfortunes or privations happened to his family at a subsequent period."—p. 54-5.

In 1800, Mr. Robert Mylne, the eminent architect of Blackfriars-bridge, who was likewise engineer to the New River Company, erected on a beautiful islet, in the centre of the basin at Amwell, a monument to the memory of Sir Hugh Myddelton, consisting of a stone pedestal of four faces, surmounted by a funereal urn. On each of the faces there is an inscription; that fronting the south, towards Amwell Spring, is in the following appropriate terms:—

SACRED TO THE MEMORY
OF
SIR HUGH MYDDELTON, BART.,
WHOSE SUCCESSFUL CARE,
ASSISTED BY THE PATRONAGE OF HIS KING,
CONVEYED THIS STREAM TO LONDON;
AN IMMORTAL WORK:
SINCE MEN CANNOT MORE NEARLY
IMITATE THE DEITY
THAN IN BESTOWING HEALTH.

The benefit which the metropolis has derived from the New River Company is incalculable. It has always been an extremely well-managed concern, and is now, amidst a crowd of more modern competitors, by far the most efficient of the metropolitan water-establishments.

"When the several reservoirs at the New River Head, Clerkenwell, were completely filled, being at an elevation of 84½ feet above the level of high water in the Thames, their capacity was adequate to the supply of the cisterns in the basement stories of the houses through the greater part of the Company's whole district, prior to 1800. About that period, however, some important domestic conveniences were introduced, which, by re-

quiring a considerable supply to the highest stories, it occasioned the frequent employment of steam-engines to force water to a height sufficient for such purposes. The additional expense of these operations led to a small increase in the charge of supplying it to the tenants; but among the striking advantages derived from using the steam-engines, was that of their affording the means to convey it sixty feet above the level of the highest reservoir, or about 144 feet above the level of the Thames. Besides this great mechanical power not only ensured a plentiful and regular supply at any altitude, and therefore the tenants materially augmented the dimensions of their cisterns, so that benefits were afforded fully equivalent to the greater cost.

"The circumstances which occasioned the use of the steam-engine to impel the water to a great elevation, likewise led to the general introduction of iron pipes, and thus the supplying of the high and low services were rendered equally efficient. At present, all the *upper* stories of a house are supplied, if required; but formerly it was the practice to supply water only to cisterns in the basement story, and hence arose the distinction between *high* and *low* service. Previous to the adoption of this plan in 1810, the complaints of a deficiency were numerous and frequent, particularly from houses situate on high ground; but subsequent to that period such instances have seldom occurred. Indeed, at the present time, the New River Company generally convey the most ample quantity to any point over the whole of their district, but especially in the direction extending to St. Martin's Workhouse, near Charing-cross, a distance of two miles and a quarter from the works; and easterly to the Custom-house, near the Tower."—p. 63-5.

"In the year 1827, the works daily supplied, at the height of 144 feet above the level of the Thames, 1,730,000 imperial gallons, according to the register of the steam-engine by which it was pumped. This, however, formed only an inferior portion of the whole supply of the Company, for it amounted, on an average, to about 8,000,000 gallons; the low service alone requiring the greater part of the water which flowed into the pipes directly from the New River Head, at the height of 84 feet above the level of the Thames, without the aid of steam-engines. But if circumstances should require a much larger quantity than has heretofore been furnished for the high service, both steam-engines* would be adequate to the raising of 8,820,000 imperial gallons, which would afford abundance to every part of the district. The aggregate annual supply, by this establishment, amounts to about 80,000,000 of hogsheads; and the whole of the district, east and west of the reservoirs, being below the level of the New River Head, of course, facilitates the supply of the mains, which being constantly kept full, are thus adapted to afford at all times a profusion of water, not only for domestic use, but likewise in cases of fires, for watering the streets, and every other purpose."—p. 74.

The histories of the rise and progress of the several other water companies of London, are characterised by a great deal of sameness; though, perhaps, this is no more than ought to be expected, where, from first to last, water is the theme. They all obtained their supplies ultimately, if not primarily, from the Thames. The exertions made by some of them to clarify their liquid commodity, have been most persevering and praiseworthy; those of the Chelsea Company in particular, under the direction of their able and intelligent engineer, Mr. Simpson. The account given of Mr. Simpson's proceedings in "Hydraulia," is by no means, however, so complete as that which was published in our own Journal, Nos. 307 and 308. Mr. Matthews mentions that Mr. S., in the course of a tour made through the kingdom in search of the best modes of filtration, "had the opportunity of inspecting filter beds which had proved completely effective for different periods of time, varying from four months to sixteen years." We have been much disappointed, however, at not meeting in the work with a description of any of these long-tested methods. The great drawback from the efficiency of all schemes of filtration is the difficulty of freeing the filters from the impurities which it is their office to arrest and detain; and as this is a difficulty which is usually found to increase from day to day, a system of filtration which can boast of having proved "completely effective" for so long a period as sixteen years, must be eminently worth knowing.

The importance of pure water is not

* Mr. M. mentions elsewhere that the Company have *two* steam-engines at the New River Head, one of which only is generally in use; "the other being kept in a state of readiness, to prevent the public from sustaining inconvenience by an interruption of the supply, in case of any accident occurring to the machinery."

for a moment to be disputed, but it must be confessed that there has been a vast deal more clamour about the "abominable," "foul," "filthy," "poisonous," "polluted," "horrible" quality of the Thames water, than there have been either facts to warrant or honesty of purpose to excuse. It is not a little remarkable, that as often as there has been a stir made to alarm the inhabitants of the metropolis about the quality of their supplies from the Thames, it has served as a precursor of some new scheme for some New Joint Stock Company, which, when incorporated, has but followed the same course as its predecessors. When, as far back as 1641, a Mr. Ford proposed a plan for bringing water from "Rickmansworth in Hertfordshire, to St. Giles's in the Fields, he felt his way by expatiating upon the muddiness of the *Myddelton* waters," defaming the quality of the commodity of the Company, with which he expected to have to compete, in order to excite notice and obtain support for his own project. Such has always been the standard mode of procedure, and so it will be to the end of the chapter. In 1827, greater endeavours than ever were made to disgust the public with good old Father Thames; the press teemed with abuse of his dirty habits; would-be-thought philanthropists took up the theme, and railed at him from a hundred rostrums; and even science lent its microscopic aid to exaggerate and caricature his faults. Mr. Matthews has ably exposed the motives of the getters-up of this panic; showing that it all emanated from a certain speculating engineer, who had a plan of his own for bringing water from the same much-abused Thames, but above Teddington lock, where the tide is supposed to have no influence in contaminating the water with the contents of the large sewers which flow into the river about the bridges.

The result of this agitation was the appointment of a Royal Commission, to inquire into the state of the supply of water to the metropolis. After an investigation, distinguished throughout for shallowness, partiality, and insufficiency, the Commissioners reported the water had "suffered a gradual deterioration within the last ten or twelve years." The only grounds, however, which they had for this decision, was the asserted fact, that the Thames formerly abounded with fish, while now they could not live in it; and the opinions of some before-unheard-of members of the medical faculty, who averred that the water was the most vile and poisonous stuff that could be imagined.

With respect to the *first* objection, there are many other things than the badness of the water which might cause the fish to remove their quarters: the unnatural disturbance of the stream, in consequence of the rapidly increasing substitution of steamers for sailing vessels, may be mentioned as one very probable cause: the greater prevalence of the use of illegal nets for taking young fry is another. The New River has not (in these our times, at least,) been denounced for insalubrity, and yet adepts at the "gentle craft" sadly complain of the scarcity of fish in that stream, in which they once sported in abundance. One specimen of the evidence upon this piscatory point is so curious, as irresistibly to invite quotation:—

"One of the witnesses represented the poor fishes to be so uncomfortable in their native element, that they actually jumped out of the water, and got on pieces of wood, to avoid its fatal effects!"

This *is* "out of the frying-pan into the fire;"—something like the showman's "wonderful animal that can't live on land, and dies in the water."

The *second* ground for the report of the Commissioners is still more satisfactorily disposed of. Dr. Bostock, whom the Commissioners themselves selected as the fittest person to report on a number of specimens of the Thames water, and whom they justly characterise as "eminently qualified for the task, by his extensive knowledge of chemistry, and his practical experience in this department of analysis," reported that

"*He was not able to discover more, on an average, than three grains of solid contents, either dissolved or suspended, in ten thousand grains of Thames water, taking the average of the different specimens.*"

The Commissioners, therefore, acted in direct opposition to their own opinion of their referee, in reporting as they did as to the quality of Thames water. And to concur with them in denounc-

ing it (by implication) as unfit for human use, because one grain in a thousand consists of extraneous matter, would be really as childish as if we were to advise our readers to eschew all vegetable food, because its very vitality is derived from putrescence; or animal food, because it exists upon the muck-supported vegetable.

The vulgar—nay, persons of all classes—are but too apt to confound "transparency" with "salubrity." Mr. Matthews mentions a fact on this head, which "furnishes a puzzling problem for solution to the pure-water philosophers:"—

"When cattle go to a stream to allay their thirst, they often abstain from drinking till they have rendered the water turbid by stirring up the sediment with their feet. Will it be unreasonable to infer that nature teaches quadrupeds that, in such a state, it is not only *wholesome*, but actually medicinal?"

Whatever may be the taste of quadrupeds in this matter, however, we bipeds will not venture to assert that muddy water is a good beverage;—though certainly there may be some truth in its being medicinal. Some of our readers will doubtless recollect a nostrum, which made some noise in its time, called "Digestive Bread," the efficacy of which was attested by the certificates of many of the faculty. The flour with which this bread was made was mixed with a quantity of bran, which was said to have a purely mechanical action upon the stomach, promotive of digestion. May not the muddy particles in water have a similar effect?

The superiority of "pure spring water" over river waters of all descriptions, is another very popular notion; but let us attend to what Mr. Matthews says on the subject:—

"Common as is the expression *pure spring water*, and generally also as the notion may be indulged, that, when obtained from wells, it is freer from admixture with other substances than that afforded by rivers; nevertheless, the recent analysis of the transparent water from the Treasury pump at Whitehall, shows it to contain extraneous matter to the amount of *four times* the quantity of the Thames at Hammersmith, and the filtered water from the Chelsea-works.

"The bad quality of the water procured from many *wells* in Southwark, was the cause of the inhabitants obtaining it from *the Thames*."

The author also combats the opinion, that the refuse from gas-houses, manufactories, and sewers, pollutes the stream of the Thames:—

"Various facts related in the preceding pages have shown the fallaciousness of the assertion that the refuse from different manufactories imparted deleterious qualities to the Thames; and, perhaps, no statement was ever less supported by rational and credible testimony. It is, indeed, far from improbable, that the substances to which the term *refuse* was applied, have a tendency to promote the decomposition of animal and vegetable matters, and really operate to render the water pure and wholesome. If the water be turbid, it may not be either filthy or noxious; and generally it becomes transparent in a short time, if kept still to allow the subsidence of the particles which occasion its opaque appearance."

The speculating water-work projectors, who have at different times endeavoured to scatter discredit upon the existing companies, in order that they might reap advantage to themselves, knowing that upon the score of bad quality alone they were not likely to make out a case, have usually combined with their attempts to turn the stomachs of the sensitive public, an attack on that other equally tender part of the body politic, the pocket. They have denounced the existing companies as constituting "a grinding monopoly," a "mischievous and unprincipled confederacy," to raise the price of an "element of nature and prime necessary of life." Truly, contentment is not in the nature of man:—of old, water was vended in London at a penny for three or four gallons (as it is to this day in Paris); and now, when the citizens get it at not so much as a *farthing a hogshead*, they cry out, and complain of its enormous price! Some show of truth there was, however, in the complaint of the water companies combining to effect a monopoly, because the rivalry existing amongst them having been carried to such a pitch, as to render it probable that ruin would eventually overtake the whole of them, they entered into a mutual agreement to terminate their differences, and to parcel out the metropolis amongst them.

"The arrangement between the New River and East London Companies was effected in 1815, by deed, which reciprocally imposed

heavy penalties for every violation of its conditions. Though this agreement terminated the competition in the Eastern part of the metropolis, yet it continued between the New River, the Chelsea, the West Middlesex, and the Grand Junction Companies, till the latter end of the year 1817, when they severally engaged to confine their operations within certain limits, and to avoid interfering with each other."

The companies might, of course, just as easily combine to raise the rates, were they so minded, as they have combined to partition the sphere of their operations; and though their defensive and offensive sort of alliance has existed for upwards of ten years without any such pernicious result, this certainly furnishes no guarantee for the future. Although, therefore, the outcry so often made about the extravagance of the rates, has but slender foundation in truth, we will not say but that it may have had the good effect of preventing the companies from abusing the power they undoubtedly possess, of exacting (for a time) what they please.

But we will allow that, if even at the rate of a farthing a hogshead, the companies had been proved to be making an enormous and unconscionable profit upon the capital risked, then might their tenants have demanded a reduction with some reason, and their opponents have had some hold upon them. Let us see, therefore, how the case stands in this respect.

The New River, for the first nineteen years, afforded only an annual dividend of 13*s.* per share, which as we have seen, increased in a few years to 145*l.* 1*s.* 8*d.*; but as the original amount of the shares is unknown, (the early books and papers of the establishment having been destroyed by fire,) it is impossible to tell what the profit now is on the amount of capital invested in the concern. According to the present selling price of the shares (15,512*l.*) the rate of profit is only 4 per cent. The Chelsea company paid no dividend for thirteen years, and the largest that ever occurred was 16*s.* on each 20*l.* share. The present profit per cent on the capital invested is 1*l* 15*s*. The West Middlesex have realised 3 per cent on the amount of their capital. The Grand Junction 2*l.* 10*s.* The East London 3*l.* 15*s.* The South London 2*l.* The Lambeth 2*l.* 2*s.* 6*d.* The Southwark, belonging wholly to one person, the profits are not known. The average (excluding the New River and Southwark Companies) is only 2*l.* 10*s.* 5*d.*, which is much less than the average rate of interest of money at the present time.

The whole question, as to the public utility and private lucrativeness of these establishments, is presented in a very striking light by the following table, which Mr. Matthews has compiled from the Returns made last year to Parliament:—

A TABLE

Showing the Number of Houses Supplied by the Water Companies of London, &c.

Name of Company.	Number of houses supplied.	Gross annual income.	Average annual expenses.*	Height of supply above the Thames.	Average daily supply to each house.	Average charge for water per house.†			Amount of capital employed.	Average value of each share.			Profit per cent. on the capital.		
		£	£	*Feet.*	*Gallons.*	£	*s.*	*d.*	£	£	*s.*	*d.*	£	*s.*	*d.*
New River ...	73,212	104,909	38,000	145	241	1	6	6	1,116,964	15,512	0	0	4	0	0
Chelsea	13,891	22,906	13,484	135	168	1	13	3	271,311	56	10	6	1	15	0
W. Middlesex	16,000	45,500	18,000	155	185	2	16	10	494,263	68	8	9	3	0	0
GrandJunction	11,140	26,154	11,000	151¾	350	2	8	6	334,174	60	4	3	2	10	0
East London..	46,421	45,234	15,889	107	120	1	2	9	594,988	118	19	11	3	15	0
South London	12,046	8,839	4,000	80	100	0	15	0	245,306	98	0	0	2	0	0
Lambeth	16,682	14,808	6,500	185	124	0	17	0	182,553	144	17	8	2	2	6
Southwark ...	7,100	7,850	No return	60	156	1	1	3	95,000	One person's property.			No return		

* In this statement of annual expenses there is no allowance to provide a fund for repairs, improvement, casualties, &c., which amount to a considerable sum.

† The average rate includes public buildings, breweries, distilleries, &c., but the rate charged to many houses is only 10*s.* or 12*s.*; and all the water for extinguishing fire is gratuitously supplied—the conflagration of a single house generally requiring from 700 to 1000 hogsheads.

The number of houses supplied in 1820, was 120,752; in 1827, 176,205; in 1833, 199,493; which shows an increase of 78,761 during 13 years, although considerably more than 10,000 houses have been taken down to effect various improvements, &c., but none erected on the same sites.

The column in this table which exhibits the "amount of capital employed" suggests some serious reflections. "Whether it be an insurmountable difficulty to form a statement which in the first instance shall approximate to the cost of a great undertaking, is a problem which, as Mr. Matthews observes, yet remains to be solved." We do not ourselves recollect a single instance, of any great public work (with the exception of Hammersmith Bridge, constructed by Mr. Tierney Clarke) being completed for a sum within the original estimate; and experience seems still to leave engineers as much in the dark as ever, as to the probable expense of such undertakings; so many and inevitable indeed are the accidents that may happen, and the unforeseen circumstances that may arise, that a tolerable approximation is all that can be expected. The mistake made in the estimates for some of the Metropolitan Water-Works have been prodigious. Sir Hugh Myddelton expected to complete the New River from his own resources, but he stopped short at Enfield, and was obliged to solicit the aid of James I, who granted pecuniary assistance for its completion. The capital of the Chelsea Company was at first 40,000*l*., but was augmented to 60,000*l*. The estimate for the West Middlesex Works was first 80,000*l*. then augmented to 240,000*l*., afterward to 340,566*l*., and eventually to about 380,000*l* It is but fair, however, to observe, that the operations of this company have been considerably extended beyond the original plan. The Grand Junction began with 300,000*l*., and only required 12,000*l*. more; this was one of the nearest estimates. The East London had first authority to raise 100,000*l*., but this sum was enlarged, at different times, nearly fourfold—380,000*l*. And the Lambeth was augmented from 96,000*l*. to 130,000*l*. Indeed, the art of estimating extensive works, seems to have quite baffled the skill of even the most celebrated of our engineers.

The scheme for supplying the whole of the Companies with "pure water" from the deep springs of the London basin (that biggest of all the *bores* wherewith the public have been bored), has been recently so fully discussed in our pages, that we need not here do more than quote a passage or two from Mr. Matthews, to show that we have him completely with us in opinion on the subject.

"Various notices have recently been given of intentions to apply to Parliament for acts to improve the existing establishments, and to form others for supplying the metropolis. Among them appears a scheme for sinking 'wells of 100 feet diameter, having a depth of 100 feet or even more until the pure spring water is produced.' According to the estimate of the projector, 'each of these will yield 100,000 barrels every twenty-four hours, and eight of the water-companies deriving their supply from the Thames by adopting this method, will be enabled to supply their tenants with *pure and wholesome* water: twenty such wells being sufficient to supply the metropolis.' This is also one of the plans proposed to the Committee in 1828 by a Mr. Henry Francis; but, on his examination, he admits that the only grounds for his calculations of their probable great productiveness were—the quantity of water appearing in different mines in *Cornwall* and other places; as well as during the excavations of the West India Docks, the Thames Tunnel, some borings at Tottenham, &c. He likewise acknowledged his inability to speak *practically*, and could only argue by analogy.

* * * * * *

"The calculation of the productive power of springs in London and its vicinity is evidently founded on a fallacious principle: for, although holes have been bored to a great depth in various places, four, six or eight inches in diameter, and water has in some instances actually risen to the surface, can these be deemed sufficient reasons for a conclusion that the same sources would furnish a constant supply for wells of several hundred times the capacity? For a few domestic purposes, wells of moderate dimensions yield but a limited supply; and even if they were twenty times the magnitude, how trivial would be their aid in various important cases, particularly in the emergencies of fires, when to extinguish the conflagration of a single house commonly requires nearly a thousand hogsheads? And would they contribute any share of the supply for cleansing the sewers, and watering the streets in summer?"—p. 443.

Mr. Matthews, it will be seen, is throughout a strong advocate of the existing companies. We cannot, however, accuse him of displaying any thing like a partisan spirit. He asserts their claims to the good opinion of the public with impartiality and fairness.

Indeed, one of the most pervading, as well as pleasing, features of the work, is the honesty of purpose by which it is animated. Although not of very great research, and consequently not so complete on some points as it might have been, yet nothing is more evident than the wish of the author to tell the whole truth, and nothing but the truth, as far as his knowledge extends. He may, very possibly, have met with difficulties in the procuring of information which do not appear on the face of his labours, and which, if known, would account for what has the appearance of want of painstaking. But such difficulties can hardly have been the cause of the paucity of information given (p. 160) respecting the Greenock Water-works; probably the most ingenious in existence, as far as regards the machinery, and the most extensive out of London, as respects capability of supply; for Mr. Thom, their constructor, has himself published a very full account of them (See Mech. Mag., vol. xvii. p. 305); nor yet of the slight mention which is made (p. 291) of the well-known works of Marli (once, at least), the pride of France. Mr. Matthews is most frequently at fault in those parts of his work which treat of the matters of art and science embraced by his subject. Take a few examples:—The Lambeth Company is stated (p. 134) to have constructed a reservoir at the top of Brixton-hill 160 feet above high-water-mark, into which the water is pumped from the Thames by a steam-engine of 110 horse-power; and two other reservoirs lower down, "the intention of one of them being to *filter the water*." Now the filtration of the water had nothing to do with the formation of either of the lower reservoirs; they were constructed simply and obviously because the steam-engine was unable to fill the reservoir at the top of the hill. Of valves (p. 308) the only sort described are the self-acting valves for the large water mains, and the screw valves in ordinary use for house cisterns; while several others quite as effectual, and a great deal more ingenious, are passed over unnoticed. The construction of the fire-plug is left to be gathered from a most inaccurate engraving, in which the spindle is ridiculously diminutive, and the shield of a form and material now never used; the old wooden shields having been long since superseded by cast-iron ones of quite a different shape. Neither is any mention made of the very improved description of fire-plug lately introduced at Birmingham, and (we believe) other provincial towns, (Mech. Mag. vol. xix. p. 444); nor more than a line or two devoted, and that incidentally, to fire-*cocks*, which ought to supersede fire-*plugs* every where. But we must cease our fault-finding, lest it should be supposed that we are less pleased than we really are with Mr. Matthews' book. We said at the outset, that it supplies a deficiency in our literature; and now having gone critically through it we feel bound to say that on the whole it supplies that deficiency well. Nor whether we look to the interest, importance, and popularity of the matters of which it treats, or to the general ability and uniform candour with which they are handled, can we doubt of its being a favourite with the public.

CORNWALL POLYTECHNIC SOCIETY.*

We extracted, in a recent Number of our Journal (No. 614), a very valuable paper from the Second Annual Report of this Society—namely, a description of Mr. Fox's Dipping-Needle Deflector; but neither the time nor space which we had then at our command, permitted of our doing that justice to the other contents of the Report, which their great importance, and the very praiseworthy character of the Society with whom they originate, call for at our hands. First, as to the Society, it appears, from the published records of its proceedings, to be one of the best—if not *the* very best—of all the associations which have sprung up in recent times, for the encouragement of a taste for intellectual pursuits among the working-classes. We know of no mechanics' institution, or school of arts, in any other part of the country (with all affection and respect be it spoken), which has produced, during any single year, or, indeed, all the years of its existence, such a volume (small in bulk though it be) of such valuable practical results as the one now before us.

* The Second Annual Report of the Cornwall Polytechnic Society, 1834. Falmouth, Trathan; London, Simpkin and Co. 83 pp., 8vo., with 13 copper-plate figures.

The success of the Cornwall Polytechnic Society seems even to have come with surprise upon its founders and promoters themselves, though, perhaps, looking at the intelligent and enterprising character of the population on whom it threw itself for support, and the intimate connexion of their prevailing pursuits with some of the grandest practical applications of science, there was really nothing surprising in the matter.

"The original design of its founders to promote the useful and fine arts; to encourage industry, and to elicit the ingenuity of a community distinguished for its mechanical skill, has been so far realised, that the Committee are now called upon to extend the sphere of their operations, and to impart to the Society a more important character than its most sanguine promoters had at first ventured to assume".—*Report of Committee.*

The Society was established in 1833, and consists now of one hundred and ninety-seven members. The minimum annual subscription is only 5*s*. A Committee chosen annually, determines on certain prizes to be offered during each year for scientific and mechanical inventions and improvements, productions in the fine and useful arts, workmanship, &c.; "and an annual exhibition is held at Falmouth (the head-quarters of the Society), for the purpose of displaying productions of art and industry;" and when the prizes offered are "rewarded to such as are deemed most deserving by judges chosen by the Committee." At the second annual exhibition, which took place on January last, the following prizes were awarded:—

For Mechanical Inventions.

For a Galvanetrical Test of Copper Sheathing. To Mr. R. W. Fox, First Prize, Silver Medal.

Copper-sheathing is often found to possess different degrees of durability, and an injurious or destructive action not unfrequently arises, from the composition of the nails not being suited to that of the sheathing; or, in other words, from their not being in electric harmony with each other. Mr. Fox employs a very delicate galvanometer to ascertain the relative degrees of liability of various specimens of this metal, and of some of its alloys, to be destroyed or decomposed by sea-water. The galvanometer is furnished with an *astatic* needle, suspended by unspun silk; and each of the wires of the instrument is connected, through the medium of small cups of mercury, with a plate of bright copper (both plates being of equal size), and immersed in sea-water, or diluted acid; small strips being partly cut off from them for the purpose of being dipped into the mercury, and establishing the voltaic circuit. The direction and extent of the deflections of the needle indicate the plate, which is the least liable to be decomposed. From some experiments made by Mr. Fox, it appeared that *annealed* copper was not at first quite so readily acted upon as a plate which had been *hammered;* or, in other words, the former was more electro-negative than the latter. This difference, however, ceased after a time, so that it may be concluded that *hammered* copper would last longer as ship's sheathing than annealed copper, from its being better able to resist the mechanical action of the water. Muntz's metallic sheathing is rather less electro-negative than sheet copper; but, possibly, its superior *hardness* may, for the reason just assigned, place it on a par with sheet copper, as it respects durability. Vivian's new metallic sheathing is harder than copper, and seems to equal it in its electro-negative quality. When sheet copper is coated with the sulphuret of copper, by throwing a little sulphur on it when heated, its electro-negative qualities are much increased. It should be observed, that when two pieces of metal of the same kind, or closely allied in their electric properties, are not immersed at the same moment, the one first put into the liquid will, for a short time, and in a small degree, give signs of decomposition; but, after a while, the action on the galvanometer is neutralised, or even *reversed,* if the metal last immersed should be less electro-negative than the first.

When metals are to be compared in this way, it is desirable that they should, after they have been made *bright,* be simultaneously plunged into the sea-water, and the experiment should be repeated in diluted acid; when the voltaic action will be more considerable, and their relative qualities, as it regards durability, will be rendered more evident.

Their electro-negative qualities may also be ascertained, by comparing the *extent* of the deflections of the needle, when different plates of sheet copper, &c., are placed on the voltaic circuit with other metals more electro-negative than copper—such as gold or silver; or less so—such as zinc, tin, &c. &c., or the native yellow sulphuret of copper or iron may be used; Mr. Fox having discovered that they are much more electro-negative than even gold or silver.

Universal Screw-Cutting Machine. Mr. R. Hosking, Perran Foundry, Second Prize, Bronze Medal, No. 1.

In common screw-cutting machines, if, at

any part of the metal to be turned, the work is required to be recommenced, and the thread to be cut afresh, the lathe must be stopped; and its motion, and consequently that of the cutter, reversed; till at the commencement of the thread, the motion must again revert to its former direction. To remedy this inconvenience, Mr. Hosking's apparatus is provided with a slide, which can be freely moved backward or forward on the rest, as may be required, without the stoppage of the lathe; and a cross slide which holds the cutter, by depressing the handle of a tooth sector to which it is subject, is propelled into action; a stay, which is also connected by links to the sector, is brought to bear on the work in the lathe, so as to prevent any vibration: a screw is applied to the cutter for the purpose of adjustment. To the cross slide is also attached the segment of an internal screw, which falls into the index screw, and is governed by the tooth sector: the index screw is worked by a tooth wheel, which is put in motion by another of the same kind, on the mandrel of the lathe.

Self-acting Gauge Cock. John Arthur, Perran Foundry, Third Prize, Bronze Medal, No. 2.

Steam Whim Engine. Mr. Jordan, Bronze Medal, No. 3.

The chief peculiarity of this engine, consists in the attaching to it an improved kibble indicator, which is capable of stopping the engine at any required time. This instrument consists of two bevelled wheels facing each other, which, by means of a solid and tubular axis, are made to carry indices in opposite directions, over a graduated dial. Motion being communicated from the crank axle, by a bevelled pinion engaging both wheels, the indices are readily adjusted to any required depth; and a provision is made for that, representing the ascending kibble, to lift a detent, and stop the engine at the proper time. The engine is also furnished with an ingenious mode of reversing its action: the eccentric, which is of the usual construction (being at liberty to move on its axis, as in marine engines), instead of being surrounded by a circular band, moves in a long double mortise, in which rollers are placed, having the distance between the nearest parts of their surfaces exactly equal to the diameter of the eccentric. A cylindrical rod, at one end of the mortise, serves as the plunger pole of the supply pump; and a similar rod at the other passes through a guide, and works the slide valve by levers: a line passing through the centre of these rods is at right angles to, and the same horizontal line with a line passing through the centre of the crank axle. It will be seen by this description, that when the centres of the eccentric and crank shaft are in a horizontal plane, the wheel will exactly fill the space between the rollers; but when these centres are in a vertical plane, only a portion of the space will be filled: this contrivance will allow the attendant to reverse the action, without throwing the machinery out of gear; when this is accomplished, the retrograde motion of the crank will immediately cause the eccentric to take up a new position on the axis, and the reversed motion will be continued.

Plan for Raising Miners. Mr. Michael Loam, Consols. Ten Guineas.

Do.—Captain W. Nicholas, Wheal Trannack. Ten Guineas.

Do.—Captain W. H. Richards, Wheal Vor. Four Guineas.

Do.—(2) Richard Bolitho. 20*s.*

Do.—James Sims. 10*s.*

Do.—Captain W. Tonkin. 7*s.* 6*d.*

"It is well known, that the only mode of access to the *Cornish Mines*, is by a suite of perpendicular, or slightly inclined ladders, sometimes uninterrupted; but more generally broken, at regular intervals, by resting places technically called *sollers*. The exertion of ascending and descending these ladders, which, in the deep mines necessarily extend to the depth of from 1200 to 1500 feet, is laborious and painful in the extreme, and often renders them totally inaccessible to the scientific and curious inquirer. The daily recurrence of this fatiguing exercise is attended with the most pernicious consequences to the miner, tending materially to impair his physical energies, to injure his health, and considerably to shorten the duration of his life. These ladders being unprotected, and naturally liable to decay; miners are continually exposed to serious and fatal accidents, melancholy examples of which are constantly occurring; and if, to avoid the fatigue of the ladders, they are induced to ascend in the buckets, the danger becomes still more imminent, on account of the obliquity of the shafts. It should also be observed that the practice, above referred to, must necessarily be attended with considerable loss to the adventurers. The amount of physical strength, which is expended in ascending and descending the ladders, must of consequence be subtracted from that, which the miner ought to devote to the interest of his employers; and the result of

his labours must be proportionably diminished."*—*Report of Committee.*

Mr. Loam's plan, which gained the first prize, consists in attaching a rod by a parallel motion to a beam connected with the moving power, and giving it an alternating action in a shaft. Platforms are affixed to the rod at regular intervals, with corresponding ones on the shaft, the distance between them being equal to the length of the stroke. It is proposed that the men shall pass successively from the platforms on the rod to those on the shaft, and back, till they are raised to the surface or lowered to the bottom. The plan is described as admitting of two rods alternating with each other; in which case the men might pass from one rod to the other, and a saving of half the time would be effected. Sufficient time for allowing the men to pass from one platform to another is provided by an eccentric motion connected with the moving power.

Captain Nicholson's plan is on the same principle as Mr. Loam's, with two rods working with a reciprocating motion in a shaft, but without any contrivance for allowing time to the miners for changing their position.

Captain Richards proposes to have a car attached to the moving power, and to work it in a rack with two cogged wheels; the platforms containing the men being suspended in such a manner that, on the breaking of the rope or chain, the action of the cogged wheels is stopped, and the car remains supported by them on the rack.

Full descriptions of these three plans, illustrated by engravings, are given in the Report.

The reasons given by the judges for preferring the principle of construction followed in the plans of Mr. Loam and Captain Nicholson, are very good:—

"We agree in deciding that less danger is to be apprehended from the passing of miners from one platform to another, than from the breaking of a rope or chain. We are also of opinion that a greater number of men can be raised and lowered in a given time by the plan of the balanced rods, which also possesses the advantage of allowing the men to pass into the several levels of the mine without the stoppage of the apparatus."

A plan, differing from both of these, was proposed by Mr. John Phillips, of Halsetown, but not laid in sufficient time before the Committee to allow it to compete for the premiums; but "on account of its simplicity and apparent practicability, and with a view to secure to the inventor the credit of the original plan, the Committee were recommended by the General Meeting to give a short description and drawings of it in the Report—" which they have accordingly done.

"Mr. Phillips proposes the alternating action of two rods in a shaft, to which rods ladders are affixed, connected by chains to cranks attached to the centres of wheels, which may be put in motion by water or steam, the chains working in grooved wheels. The miners may pass from one ladder to the other, at the termination of each stroke of the rods; which will take place when the cranks have arrived at their dead points, and their motion consequently gradually stops; sufficient time will thus be afforded for their changing their positions: by this plan any number of men might ascend and descend, meet and pass each other, without hindrance. Mr. Phillips calculates that by his plan, men may be raised at the rate of 100 fathoms in five minutes; that his apparatus need not occupy a greater space than 4 feet by 3 feet in the shaft; and that it is equally applicable to perpendicular and underlying shafts. He also proposes the introduction of some machinery, to provide a longer time for the stoppage when the cranks arrive at their dead points, and to equalise their velocity in the other parts of their revolution."

* The following calculation has been made of the amount of human labour, expended in this fatiguing exercise; which places its great disadvantages in a striking point of view. Suppose a man to weigh 160lbs.; in ascending 260 fathoms (the depth of the Consolidated Mines) in *one hour*, which is much below the average computation, he exerts a constant force equivalent to that required in raising 4160lbs. one foot in a minute, or rather more than one-eighth of a horse power; and supposing *one-third* of this force is expended in the descent, since a man could not continue such an exertion more than 4 hours, one-third of his whole physical strength is exhausted in going to and returning from his work. There are certainly few mines as deep as the Consolidated, and all the men do not work in the lowest levels, but those mines which give any considerable employment, are generally worked to great depths:—*one-fifth* therefore may fairly be considered as the average proportion of labour so expended. This practice is attended with serious disadvantages to the miner and adventurer, who, according to the system of mining in Cornwall, are equally interested in the *amount* of work completed; and where a great number of men are employed, the loss accruing to the latter must be considerable.

The Committee remark that "these plans, though capable of immediate adaptation to the Cornish mines, are no doubt susceptible of further improvements, which it is confidently hoped—the attention of the public being now drawn to the subject—will be applied so as eventually to supersede the present dangerous system;" and they add, in a note, that "a premium of Ten Guineas is now offered by J. H. Tremayne, Esq., for the best available improvement on these plans."

New Sun-Dial. William Motton. 10*s.*

Steaming Apparatus. Wm. Boaz. 5*s.*

For Models not Displaying Invention.

Steam-Engine. John Mitchell, First Prize, Bronze Medal, or 2*l.*

Electrifying Machine. Thos. Olive.

Columbian Press. James Genn.

For Naval Architectural *Improvements.*

Model of a Boat built from Lines. J. S. Enys, First Prize, Bronze Medal.

New Plan for Fidding or Unfidding a Top-mast. Lieut. Foster.

Paddle-wheel for Relief of Backwater. Joseph Beard.

Portable Breakwater. Constantine Tripconney.

For Works in the Fine Arts.

Figures Cast in Iron. Mr. Nich. Harvey Hayle. First Prize, Bronze Medal.

"These figures, representing a Grecian and a Roman warrior, elicited universal admiration, and were generally allowed to rival in their execution some of the best productions of the Continent."

Series of Drawings of a Gas-Apparatus. Mr. Gilbert.

"These drawings represent an apparatus for the manufacture of gas from resin, with the improvements proposed by Mr. Gilbert; which he states have been partly adopted in Flanders, and raised the supply of gas from the same quantity of resin, from 800 to 1,400 cubic feet. The medal was awarded for the drawings only, which are executed in an admirable style, and deserve the highest commendation."

Thirty others.

Natural History Specimens.
Three prizes.

Fancy Work.
Thirteen.

Miscellaneous.
Four.

Besides the inventions and improvements included in this prize list, there were some others of not inferior value brought under the attention of the Society at their last Annual Meeting, without any view to competition. Amongst these we may mention Mr. Fox's Dipping-Needle Deflector, the account of which we transferred to our pages some weeks back; Messrs. Petherick and West's New Boiler (noticed in Mech. Mag., p. 64, present volume); and the important improvement in blasting, described in the following passage of the Committee's Report:—

"Those who are conversant with mining operations, are also aware, that the present mode of *blasting rocks* has long been considered, by the best practical judges, to be objectionable; and the attention of some eminent scientific individuals has been directed to the subject, with a view to discover some more sure and effectual method. That, now generally adopted, is to bore the rock to be removed to a sufficient depth; and the charge being applied, a quantity of clay, or pounded stone, is superposed, and beaten down very firmly upon it, through which the reed or fuse is inserted: this process is called *tamping*, which occupies a considerable portion of time and labour, and is not unfrequently attended with serious accidents, in consequence of the premature ignition of the powder during the operation. During the last year, a premium was offered by the respected President of this Society, Sir Charles Lemon, and R. W. Fox, Esq., for the best series of experiments, tending to prove, how these dangers may be most effectually and economically guarded against; and although no plans were laid before the Committee at the time specified by them, experiments have been made by some individuals, both in the neigbourhood of Penryn, and at Tintagel near Camelford, in a manner satisfactory to well known practical miners; and which will, it is hoped, be fully matured previously to the next exhibition. The proposed method is, to place over the charge a metallic disc closely fitted to the hole, which is then filled with loose sand. The disc, being bored for the purpose of admitting the fuse, presses against the whole surface of the sand; which, forming systems of arches, offers such powerful resistance to the powder, as greatly to increase its explosive force. The firmest and hardest rocks have been blasted by this method, which, by the experiments made at Tintagel, by Mr. E. J. Jeffray, has been found to effect a saving of *one-fifth* of the time and labour, required under the present system; while the dangers attendant on tamping are wholly obviated."

ARCANA OF SCIENCE FOR 1834.

This new volume of our scientific Annual Register* presents no novelty in its plan calling for particular remark: in every feature it is the very "counterfeit presentment" of its brother of last year—the freshness of its information, of course, excepted. If any thing, we think a little more attention is paid, and much more room given, to the mechanical department than before. About ninety pages are devoted to it, a number which, if our recollection serves aright, is considerably above the usual average; and this, so far, is certainly an improvement.

The editor's principal sources for his information, in this division, have been, as usual, our own pages; and, after them, the columns of the Repertory of Arts, the Athenæum, and the Printing Machine. The extracts from the last almost exclusively relate to continental matters of science, the only domestic article taken from it being an account of the visit of divers "illustrious foreigners" to that more foreign than English curiosity, the Thames Tunnel. From the Mechanics' Magazine the extracts are numerous and long, as may be conjectured from the very titles of the principal articles in this division, as referred to in the Preface;—to wit, Double Steam-vessel in America; Hancock's New Steam-carriage, "Era;" New Mode of Illuminating Lighthouses: Erection of the Duke of York's Column; Herschel's Improved Reflecting Telescopes; Birmingham Town-hall and its Organ; Railways in America; Babbage's Calculating Machinery; Depth of Mines; Improvements in Steam-Navigation, Steam-Carriages, and Railways; Dublin and Kingstown Railway; and Reports of the Annual Meetings of the British Association for the Advancement of Science, and the Society of Arts.

With some difficulty we have contrived to select a "taste of the quality" of the Arcana, from this section, which may probably be new to our readers. If all things were improved, like East India Madeira, by a roundabout voyage, the article we are about to quote ought to be peculiarly rich and racy, since it is transferred to our pages from those of the Arcana of Science, at which it arrived by way of "The Printing Machine," from the original vintage of the "*Exposition des Produits de l'Industrie Française, en* 1834."

"During the last thirty years, the manufacture of bronzes has acquired considerable importance in France; and as this branch of industry owes the impulse it has received to the good taste of the French artists, it has had no competition to encounter in foreign markets. The principal seat of the manufacture is at Paris, where so many as 250 houses are exclusively engaged in the manufacture of every description of articles in bronze. The number of workmen is estimated at 5,000; and if we add to them the gilders, who form a distinct body, the number of persons, masters and workmen, who find in the bronze manufacture a steady and lucrative occupation, will amount to nearly 6,000. The manufacture is estimated to produce annually the sum of about 800,000*l.*, of which, from 400,000*l.* to 500,000*l.* is the value of articles sold in France, and from 280,000*l.* to 320,000*l.*, the price of articles exported to foreign countries. At Paris, there are made every year 15,000 bronze clocks, 40,000 pairs of candlesticks, 3,000 pairs of candelabras, and 100 *surtouts de table.** It would be desirable to include in this enumeration the glass covers for the clocks, lamps, &c. &c. The number of glass cases annually required for such purposes is estimated at 60,000. For some time past, the use of bronze in the manufacture of chandeliers and lamps has become very common, and the employment of the article is daily becoming more extensive, both for ornament and use. The division of labour is now established on a large scale in this branch of manufacture; and many founders employ a large number of workmen in making one particular part of an article. The importance of the manufacture of articles of luxury in bronze, some beautiful specimens of which appeared in the great exhibition of French machinery and manufacture at Paris, a few months since, cannot be estimated with so much precision as that of the bronzes of commerce, as it depends on particular circumstances, which do not act with regularity. The following statement is given in reference to the bronze manufactures of Paris alone:—

* Arcana of Science and Art, or an Annual Register of Useful Inventions and Improvements, Discoveries and New Facts, in Mechanics, Chemistry, Natural History, and Social Economy. Eighth Year. London, 1835. Limbird. 8vo. pp. 315.

* By this we understand large ornamental vases for holding flowers, which are placed in the centre of the table at large dinner parties.

15,000 clocks, at the average price of 10*l*.	£150,000
40,000 pairs of candlesticks, at 16*s*.	32,000
3,000 pairs of candelabras, at 8*l*.	24,000
100 *surtouts de table*, at 60*l*.	6,000
60,000 glass covers, at 8*s*.	24,000
Chandeliers and lamps	40,000
Small articles	72,000
Articles of luxury	80,000
	£428,000

"Since the founders have employed, in the manufacture of ornamental bronzes, one-third of zinc, the cost of which is less than that of copper, the price of the material, and consequently of the article manufactured from it, has been reduced, and the demand has increased in proportion."

All this proves, at any rate, that the Frenchmen of the present day are not likely to be found wanting in brass; a commodity in which few would expect them to be deficient. Other nations may possess *quantum suff.* of the raw material, but it requires "the good taste of the French artists" to set it off to the best advantage! Joking apart, the details of their progress in bronzing are not uninteresting, and the whole statement well deserves the consideration of our own manufacturers. If the men of Birmingham were once fairly put "on their *metal*," by being made fully aware of the advantages of the trade, we doubt not that they would soon try on a little "competition in foreign markets" with their Parisian brethren.

Under the head "Chemistry," there are a variety of curious particulars on the subject of the quality of gas supplied to the metropolis, from a Lecture by Professor Brande. It will be seen that the quantities stated, from the partly conjectural manner in which the data have been obtained, can only be approximative to the truth.

"Mr. Brande estimated the number of retorts worked by the above-mentioned company (the Chartered) at 750; and, assuming them to be about one-fourth of the number employed in London, the whole amount will be 3,000 retorts, of about 15 cwt. each; so that the cast iron thus employed, to say nothing of the enormous amount in pipes and other apparatus, amounts to 2,240 tons. The total stowage for gas, in the gasometers of the chartered company, Mr. Brande estimated at 820,000 cubic feet; or, for London, 3,280 000 cubic feet. He said that the number of burners supplied by this company amounted to about 42,000; or, for the whole of London, to 168,000; and, estimating the consumption of each burner at five cubic feet per hour, the average *hourly* consumption of gas would amount to 840,000 cubic feet; and taking five hours per day as the average time of burning, we have 4,200,000 cubic feet of gas as the daily average consumption. * * * For the total annual supply of gas to the metropolis, there are required 200,000 chaldrons of coal, yielding 2,400,000,000 cubic feet of gas; the gas weighing 75,000,000 lbs. The light thus produced is equal to 160,000,000 lbs. of mould candles, of six to the pound; the bulk of the coal is equal to 10,800,000 cubic feet, or 400,000 cubic yards; or to a cube of 222 feet in the side, or of 74 yards."

The remaining portions of the volume are occupied by matter of the usual calibre, and the Scientific Obituary is as brief as ever. The illustrations for the first time, we believe, are *all* wood-cuts, and all taken from "The Mirror," except one or two (including the frontispiece, "Buckingham Palace Gates") which have, since the appearance of the Arcana, been transferred *to* the Mirror.

BOOKBINDERS' IMPROVED LETTERING-TOOL.

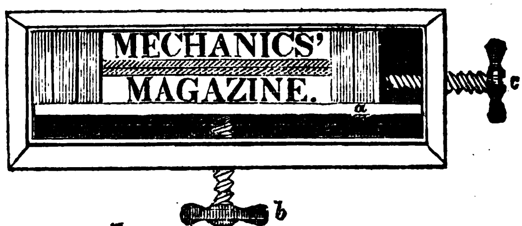
Sir,—Just two years since I suggested an improvement in bookbinders' lettering apparatus, which I described in No. 511 of your Magazine (vide vol. xix. p. 120). Since that time my suggestion has been successfully acted upon, and the apparatus has been brought into very general use.

The accompanying sketch, fig. 1, represents the improved lettering-tool, as it is manufactured by Messrs. Seare and Co. (late Paas), High Holborn. Fig. 2, is a face view of the apparatus, with the lettering for a justly celebrated work set up; spaces are introduced at either end to bring the words into the middle of the chase, perpendicular to the handle, which is essential to good working. The hand-chase is of brass, and for the purpose of accommodating letters of different sizes, a moveable partition *a* moves backward and forward by means of the front screw *b*; so that the same chase serves for several sizes of letters, and either single or double line letterings (if small) can be set up. When the letters are placed, they are screwed by tightening the end screw *c*. The letters are cut on the top of brass blocks, similar to type; a set of letters consists of about ninety pieces, and costs two guineas; the hand chase costs 10*s*. 6*d*.

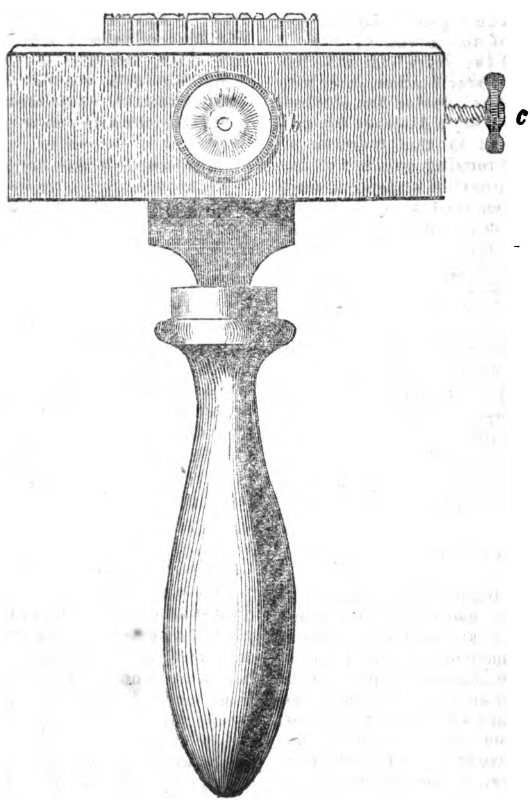
By the use of this convenient and economical apparatus, a more even and

uniform appearance is given to the lettering, with much less trouble than letterings in the usual manner. The letters can be looked out and set up in nearly the same time that the present letters can be gathered, and the whole title is worked off in the same time that a single letter would occupy.

When this apparatus is employed, the cutting of expensive pallets (which



1



are afterwards useless) for large sets of books, is rendered unnecessary, as these letters can be set up and form the required pallet, and afterwards be transposed to suit other similar purposes.

This mode of working letterings is highly advantageous; it saves time, labour, and expense, and ensures a neatness and uniformity of workmanship not otherwise attainable.

I remain, Sir,
Yours respectfully,
William Baddeley.

London, June 9, 1835.

A BILL, INTITULED AN ACT TO AMEND THE LAW TOUCHING LETTERS PATENT FOR INVENTIONS.

(*Presented by the Lord Brougham and Vaux.*)

I. Whereas it is expedient to make certain additions to and alterations in the present law, touching letters patent granted to authors of inventions, as well for the better protecting of them in the rights intended to be secured by such letters patent, as for the more ample benefit of the public from the same: be it enacted by the King's most excellent Majesty, by and with the advice and consent of the Lords, spiritual and temporal, and Commons, in this present Parliament assembled, and by the authority of the same, that any person who hath obtained or who shall hereafter obtain letters patent, for the sole vending or using of any invention, may, if he think fit, within two years from and after the enrolment of his specification, enter with the secretary of patents, having first obtained the leave of his Majesty's Attorney General, or Solicitor General in case there be no Attorney General, certified by his fiat and signature, a disclaimer of any part of his said specification, stating the reason of such disclaimer; and such disclaimer shall be filed by the said secretary of patents, and by him notified three times in the *London Gazette*, in three successive weeks next after receiving the same, and also in two morning and two evening newspapers published in London, once in each such successive weeks; and such *London Gazettes* shall be received in evidence of the disclaimer, and of the Attorney General's or Solicitor General's assent thereto, in all courts whatever, and shall be conclusive evidence thereof; and no part of the residue of such specification, or of the letters patent in respect of the right to the sole using and vending the invention set forth in such residue, shall be deemed or held to be void by reason of the error, or want of originality, or other matter touching or connected with the parts so disclaimed as aforesaid: provided always, that the secretary of patents shall be, and he is hereby required to make such publication as aforesaid; and if he neglect to advertise in the *London Gazette* as aforesaid, he shall be liable to forfeit and pay the sum of 500*l.* for each such neglect, to be recovered by action of debt, bill, plaint, or information in any of his Majesty's Courts of Record at Westminster, one half to his Majesty, his heirs, and successors, and the other half to any person suing for the same; and for any neglect in advertising in the other London newspapers, he shall pay and forfeit 50*l.*, to be sued for and recovered, and applied in the like manner.

II. And be it enacted, that any person having obtained heretofore, or who shall hereafter obtain, such letters patent as aforesaid, may, within six calendar months after enrolling his specification, cause to be inserted three times in each of three morning and three evening papers published in London, and three times in each of two newspapers published in the town in which, or nearest to which, he carries on the manufacture of his invention mentioned in such letters patent, or if no newspaper shall be published in such town, then in two newspapers published in the county wherein he so manufactures, or the next adjoining county, and if he carries on no manufacture then in the town in which, or nearest to which, or the county in which, or near to which, he resides; a particular statement of the nature of his invention, with reference to some place in London, and also to some place in the said town, to be specified in the advertisements aforesaid, where the drawings illustrative of the same may be seen, and where also a working model of the invention may be seen, which drawings and models shall remain at such place from the date of the first advertisement till one calendar month after the last advertisement aforsaid; and upon proof of such advertisements, and of such drawing and model being so as aforesaid, deposited for the time aforesaid, if any action or suit shall be commenced, more than 18 calendar months after the enrolment of the specification, to set aside such letters patent, or if any action or suit shall be brought against any person for infringement of such letters patent, or for an account in respect thereof, in respect of any thing done after 18 months from the enrolment of the specification, no evidence shall be received that any other person than such patentee, had made or used his invention or any part thereof, at or before the date of the patent, but a verdict shall pass at law, or decree or order shall be made in equity, as if no other person than the patentee had ever used or sold the same at such date as aforesaid.

III. And be it enacted, that if any action at law or any suit in equity shall be brought for an account in respect of any alleged infringement of such letters patent, heretofore or hereafter granted, or any scire facias to repeal such letters patent, and if a verdict shall pass for the patentee, or if a final decree or decretal order shall be made for him, upon the merits of the suit, it shall be lawful for the judge, before whom such action shall be tried, to certify on the back of the record, or the judge who shall make such decree or order, to give a certificate under his hand, that the validity of the patent came in question before him, which record or certificate

being given in evidence in any other suit or action whatever touching such patent, if a verdict shall pass, or decree or decretal order be made, in favour of such patentee, he shall receive treble costs in such suit or action, to be taxed at three times the taxed costs, unless the judge making such second or other decree or order, or trying such second or other action, shall certify that he ought not to have such treble costs.

IV. And be it further enacted, that if any person who now hath or shall hereafter obtain any letters patent as aforesaid, shall advertise in the *London Gazette* three times, and in three *London* papers and three country papers as aforesaid, that he intends to apply to his Majesty in Council for a prolongation of his term of sole using and vending his invention, and shall petition his Majesty in Council to that effect, it shall be lawful for any person to enter a caveat at the council-office; and if his Majesty shall refer the consideration of such petition to the judicial committee of the Privy Council, and notice being given to any person or persons who shall have entered such caveats, the petitioner shall be heard by his counsel and witnesses to prove his case, and the persons entering caveats shall likewise be heard by their counsel and witnesses, such counsel not exceeding three, if there be more parties than one, and two if there be but one party entering a caveat: whereupon, and upon hearing and inquiring of the whole matter according to law, the judicial committee may report to his Majesty that a further extension of the term in the said letters patent should be granted, not exceeding seven years. And his Majesty is hereby authorised and empowered, if he shall think fit, to grant new letters patent for the said invention, for a term not exceeding seven years after the expiration of the first term, any law, custom, or usage to the contrary in anywise notwithstanding.

V. And be it further enacted, that any person purchasing from another the property of and in any invention by him made, may afterwards obtain in his own name letters patent in like manner as he might have done in case he had been himself the inventor, and shall have and enjoy all privileges and rights, in courts of law, and equity, and elsewhere, which the inventor himself might have had in case he had obtained such letters patent. Provided always, that such purchase shall be stated in the specification to be enrolled, and also that such purchaser shall produce before the Attorney General or Solicitor General, before obtaining such letters patent, the deed or agreement of purchase. Provided further, that, in any suit or action touching such letters patent brought by or against such purchaser, all evidence which would have been admissible against such inventor if he had obtained such letters patent, and been a party to such suit or action, shall be admissible against such purchaser, and that the inventor shall not himself be an admissible witness in behalf of such purchaser in any such action or suit. And provided further, that, whatever matter or thing would have made such letters patent void or voidable in case such inventor had obtained such letters patent, shall, if proved in any suit or action by or against such purchaser, also make his letters patent void or voidable.

VI. And be it further enacted, that in all suits and actions, and for all purposes whatever, the day of presenting a petition for such letters patent shall be deemed and taken to be the date of the granting such letters patent, and the grant shall have effect from the date of such petition, from and after the enrolment of the specification, or the performance of any other condition in such letters patent contained.

VII. And be it further enacted, that his Majesty's Attorney General, or Solicitor General in case there be no Attorney General, shall and may require the person applying for any such letters patent to alter the title thereof, and the statement of the invention in such title, so as to make it describe more particularly and more correctly his invention according to the true nature thereof.

VIII. And be it further enacted, that it shall be lawful for any person obtaining such letters patent to sell or transfer to any number of persons the right solely to use and vend his invention, or may grant licence to use and vend the same to any number of persons in the same or in several instruments of licence, any law, custom, or usage to the contrary in anywise notwithstanding.

IX. And be it enacted, that, in any action brought against any person for infringing any letters patent, the defendant, on pleading the general issue, shall give to the plaintiff, and in any scire facias to repeal such letters patent, the plaintiff shall file with his declaration a notice of any objections on which he means to rely at the trial of such action, and no objection shall be allowed to be made in behalf of such defendant or plaintiff respectively at such trial, unless he prove service of such notice of objection upon plaintiff or defendant respectively twenty-one days at least before such trial: provided always that it shall and may be lawful for any Judge at Chambers, on summons served by such defendant or plaintiff on such plaintiff or defendant respectively, to show cause why he should not be allowed to offer other objec-

tions whereof notice hath not been given as aforesaid to give leave to offer such objection, on such terms as to such Judge shall seem fit.

X. And be it enacted, that, if any person shall write, paint, or print, or carve, or engrave, upon any thing made or sold by him, the name of any other person who hath or shall have obtained letters patent, for the sole making and vending of such thing, without leave in writing of such patentee; or, if any person shall upon such thing, not having been purchased from the patentee or some person who purchased it from such patentee, or by leave in writing of such patentee, write, paint, print, carve, or engrave the word "Patent," the words "Letters Patent," or the words "By the King's Patent," or any words of the like kind, meaning, or import, he shall, for every such offence, be liable to a penalty of *50l.*, to be recovered by action of debt, bill, plaint, or information in any of his Majesty's Courts of Record at *Westminster*, one-half to his Majesty, his heirs and successors, and the other to any person who shall sue for the same.

[We shall reserve the statement of our objections to this Bill till next week. No harm can result from this delay, as from the late period of the year at which the Bill has been brought forward, it is not possible that it can be carried through this session, even were it unopposed, and perfectly unexceptionable.—Ed. M. M.]

AMERICAN MANUFACTURE OF AXES.

[Extract of a Letter from the New-England Farmer.]

"Being lately at Douglas, Mass., I was invited by my friend, Griffin Clark, Esq., of that place, to visit the manufactory of axes, belonging to Messrs. Hunt and Co. At this establishment, about 500 axes and hatchets are manufactured in a day, of all descriptions, and of the most beautiful and perfect workmanship, and chiefly by a new mode. Besides adzes, and a variety of other species of edge tools, I noticed the Pittsburg broad-axe; it is not deep, but the broadest of all I have ever seen; the edge straight, and about sixteen inches in its width; its form resembles the ship-carpenter's axe. The Kentucky axes differ from our chopping axes, only in being heavier, and having a very long bit. The chopping axes, and all of a larger size, are formed in the usual way, by doubling the iron; but all of the smaller description are formed by a new and more expeditious mode. Bars of cold iron, about an inch thick and four inches wide, more or less, according to the size of the intended axe, or hatchet, are cut into suitable lengths with ponderous shears.

These pieces being cast into the forge and brought to the required heat, are cleft at one end, and into this cleft a tongue of cast steel is inserted; then being again heated, the complete union of the iron and steel is effected with the hammer. These being subjected anew to the fire, are laid on edge in a mould, and a single and powerful blow, or pressure of an engine, completes the profile of the small broad axe or hatchet, and this blow being repeated a second time, renders the outline still more perfect. They are next transferred to another engine, furnished with a die: in this the axe is laid, and a heavy weight of iron, similar to those used in driving piles, being drawn up suddenly by water power, completes the form of the axe by its fall.

"Another engine is about going into use, which will give to the rough and oblong section of a bar of iron the form of a perfect and beautiful axe or hatchet at a single and instantaneous operation. Thus are these instruments formed; but the eye for the insertion of the handle is made by boring through the cold and solid iron. The axe being fixed in a firm position above, a vertical drill of species of auger perforates them from below. This auger has a threefold motion. First, a revolving motion on its own centre. Second, it moves in an orbit, which is that of a very eccentric ellipsis, corresponding with the form of the eye. Third, a vertical or upward motion at intervals; and at each time it has completed a revolution in its orbit.

"An axe is bored in about twenty minutes; and one man will attend to twenty-five augers or axes; and another man is sufficient to sharpen the drills or instruments for the same.

"Respectfully, your friend and obedient servant,

W. K."

NOTES AND NOTICES.

Balloon Excursion Extraordinary.—The *New York Journal of Commerce*, of the 27th, states, that, "on the afternoon of Wednesday, the 8th inst., Mr. Clayton, a volunteer aeronaut in the West, made an ascent from Cincinnati, and was observed to pass off in a south-easterly direction. Nothing more was seen or heard of him for a number of days, and great anxiety was felt for his safety. At length, on the 17th (nine days after his departure), he returned to Cincinnati, having made the most extraordinary aeronautic excursion on record. He did not, indeed, ascend so high as a number have done before him, but the distance he sailed is beyond all precedent, being not less than 350 miles. All this was accomplished in 9½ hours, which is at the rate of nearly 37 miles an hour. The greatest height to which he ascended was about 2½ miles." The longest aerial voyage previously on record was, we believe, that of M. Garnerin in 1807, who travelled 300 miles in 7½ hours, which is a rate of speed a little greater than that realised by Mr. Clayton.

A Bull-fight with Steam.—A few days since, as a locomotive-engine was passing along the Colum-

bia Railroad, the engineer espied a noble bull driving across the field, apparently to give battle, to the machine. He was coming at the top of his speed, his tail stuck right up into the air, and his head down, as if for immediate attack. As the bull errant rushed onward, the director stopped the car, and received the blow upon the front wheel. The animal recoiled several steps—the puffing of the steam-pipe seemed to challenge him to another onset, and on he came, bellowing, and tearing up the earth, while his eyes seemed to shoot forth baneful fire. The engineer thought that his safety consisted in moving—he therefore put on the whole head of the accumulated steam, and the car started like the wind. The enraged beast struck short of his aim, he missed his footing, and rolled down a high embankment, to the infinite gratification of those who had watched his behaviour, and to the glory of the engineer.—*U. S. Gazette.*

India-Rubber Whips.—"One of your correspondents has suggested the employment of India-rubber as a material for whips. India rubber whips were in use fourteen years ago, under a patent taken out by somebody; but the manufacture of them was abandoned, from which it appears reasonable to conclude that they were not found to answer in practice so well as the ordinary leather whips."—G. R. 10*th June.*

"*An India-Rubber Boat* has been lately announced as a Yankee wonder; but Captain Parry took out a boat of this description with him on his last expedition; and there are now among the naval stores at Portsmouth, one or two India-rubber boats, constructed by Mr. Cow, of his Majesty's Dock-yard, Woolwich, who published a Treatise on Boats in 1829, in which the advantage of using caoutchouc boats, in certain cases, is strongly insisted upon. I know, also, that Mr. Thos. Hancock, the eminent caoutchouc manufacturer, has often proposed to make air-boats of nothing but India-rubber-cloth (without spars or timbers of any kind), that would go into a sufficiently small compass to be packed up in a portmanteau; but I do not know whether he ever reduced his ideas to practice."—*Ibid.*

Mr. Troughton, the eminent mathematical and philosophical instrument-maker, died at his house, Fleet-street, on the 12th instant, at the advanced age of 81. Mr. Troughton was a Fellow of the Royal Societies of London and Edinburgh, the Astronomical, and various other learned Societies; and not less highly esteemed among scientific men than beloved and respected by his friends.

The Institute of British Architects held their opening meeting on Monday last. Earl De Grey, the President, was in the Chair, and the attendance of Fellows, Ordinary and Honorary, and of distinguished strangers, extremely numerous. The evening was chiefly occupied with the reading of an excellent address, by T. L. Donaldson, Esq., the Honorary Secretary, on the objects and prospects of the Institution. Although but in the second year of its existence, there are already above sixty members of the profession belonging to it, many of them of the first eminence—and its library of reference contains numerous rare and expensive architectural works, engravings, models, &c. Of the utility of the Institution, both to the profession and to the public, there can, we apprehend, be no doubt; and of its great success we are happy to say just as little.

Mr. Collier's Boiler.—We are assured by Mr. Collier that the failure of his boiler on board the Meteor is to be attributed to a misconstruction, which "was perfectly known to the Lords of the Admiralty before the Meteor sailed, and was protested against by him; nay, more, that their Lordships have not, on account of what has happened, in the least hesitated to pay for the boiler." The failure arose from the bottoms of the chambers burning out, and that arising from the space left between the furnace bars and the chambers being too small—only ten inches. The space would have been sufficient (Mr. Collier thinks), if Newcastle coal had been used, which is that with which all his own experiments in generating steam have been made; but the coal used on board the meteor was Welch, which requires to be burnt in much thicker layers. While we insert this statement, in justice to Mr. Collier, and at his request, we think it only fair to add, that the same correspondent from whom we received the account of the failure of Mr. C.'s boiler, informs us, that though it is quite true the Lords of the Admiralty have paid for the discarded boiler, they only paid for it the price of old iron.

Brick-making Machines.—Messrs. Ride, Coleman, and Co., of the Vauxhall Works, Leicester, have written to us in reference to the inquiry of the Brickmaker at Shrewsbury, published in our Journal of May 30. "We make," they say, "clay-mills, for grinding clay, with two cast-iron rollers fixed in an iron and wooden frame, worked by a horse, with wheels, shaft, and suitable gearing for the same. The price in Leicester is 40*l.* When limestones are found in the brick-earth, we consider it the best plan, at present known, to pass the earth through the rollers, which work so close together as to break the stones; thereby preventing the bricks from bursting, from the lime in them expanding with the wet."

"King Williams." We should be glad to be favoured with this person's address. He was the inventor of a paddle-wheel exhibited some years ago at the National Repository.

We have not overlooked the letter of "Mechanicus" on the Patent Laws, and shall avail ourselves of its aid, in due season.

The Evidence given by Dr. Lardner on the Western Railway Bill has not yet fallen in our way; but if all the opinions he has hazarded had been only as sensible as that which "Carlisle" finds fault with, it would have been well for his scientific reputation. We think it not only very plausible, but strictly demonstrable; we must first, however, have an authentic version of the opinion, before we can open our pages to a discussion of its merits. Can Carlisle, or any other of our readers, favour us with a sight of the evidence?

Communications received from Scrutator Mechanicus—Mr. Harvey—Mr. Daglish—Treble Boat—Mr. Ja. Jones—A Cotusona—A Hamburger.

The Supplement to our last Volume, containing Titles, Index, &c., with a Portrait, on Steel, of Samuel Clegg, Esq., C. E., is now published, Price 6*d*; also the Volume complete, in boards, Price 8*s*. 6*d*.

Our Publisher will give One Shilling and Sixpence for copies of the Supplement to Vol. IX.

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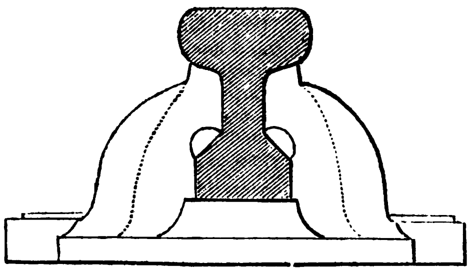
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 620. SATURDAY, JUNE 27, 1835. Price 6*d*.

DAGLISH'S PRIZE RAILS AND PEDESTALS.

Fig. 1.



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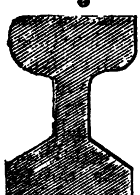

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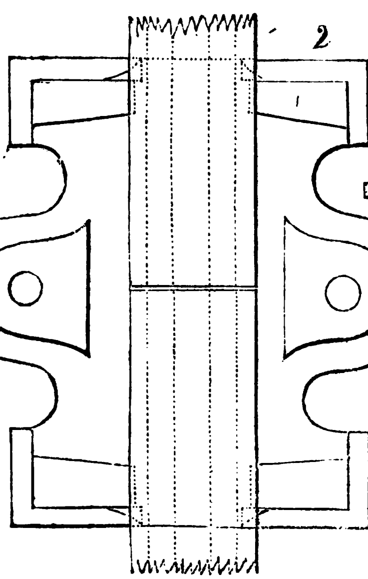

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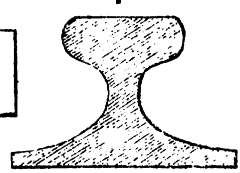


DAGLISH'S PRIZE RAILS AND PEDESTALS.

Dear Sir,—I herewith send you drawings of my parallel rail and joint and intermediate pedestals, with the mode of fastening them to the stone blocks or sleepers, and also of my method of keying the rails into their respective pedestal; for all which I obtained the premium lately offered by the London and Birmingham Railway Directors, with the exception of the mode of fastening the pedestals to the stone blocks, which the Committee of Reference are said to have thought inferior to the lewis-pin of Mr. Swinburn, to whom the Directors accordingly awarded a third of the premium. I have also added sketches of certain modifications of my rail and pedestals, which it might be advisable to adopt under particular circumstances, and in some peculiar localities.

Fig. 1 (No. 8 of the Competition) is an end-section of the parallel rail and *joint*-pedestal (the pedestal where two ends of different lengths of rail meet); shewing also the mode of keying the rail by cotter bolts (No. 3 of the Competition). Fig. 2 is a plan of the above; and fig. 3 a side-section. The weight 50lbs. per yard. The stone blocks are from 10 to 12 inches thick, and contain from 4 to 5 cubic feet; the cotter bolts are ¾ inch round.

I have tried this form of rail against ten other forms of rail of the like weight per yard or thereabouts, not only by actually running heavy locomotive-engines over them, but by means of the steelyard and lever, and have always found that it will carry more weight than any other with the least deflection. The simplicity of its construction, too, is greatly in favour of its being soundly made.

Fig. 4 is an end-section of the same kind of rail, with the *intermediate* pedestals; and fig. 5, plan of the same.

The joint-pedestal is made of nearly twice the bearing of the intermediate ones, in order that the ends may be the more effectually secured.

The Secretaries of the London and Birmingham Railway state, in their letter to me announcing the award of the premium in my favour (with the exception aforesaid), that the Committee of Reference did not consider that any one of the patterns or plans sent in fulfilled the conditions required by their advertisement (that is to say, I presume, combined in one, all the advantages sought for), but that my form of rail and chair (or pedestal), and mode of fixing the rail to the chair (according to the chair pattern, No. 3, and model, No. 8), were the best as regards the two first conditions of the advertisement; while the method of fixing the chair to the stone block, shown in model No. 5 (Mr. Swinburn's), was the best as regards the third condition; and that the Directors had, therefore, come to the unanimous resolution, that they should not be justified in giving the premium for any one individual pattern or plan, but that 70*l.* of it should be awarded to me, and 35*l.* to Mr. Swinburn.

On comparing, however, the statements in this letter with those in the pamphlet lately published by Mr. Barlow (one of the Committee of Reference), containing an account of the experiments made by him at Woolwich, and his Report thereon to the London and Birmingham Railway Directors, I must confess that I am a quite at a loss to reconcile the two. For it appears from the latter, that Mr. Barlow not only made his experiments with my form of rail, which he pronounces to be by far the best, but recommends the mode which I proposed of fixing the pedestal to the stone block, *and not Mr. Swinburn's.*

Indeed, to all who are practically con-

Fig. 3.

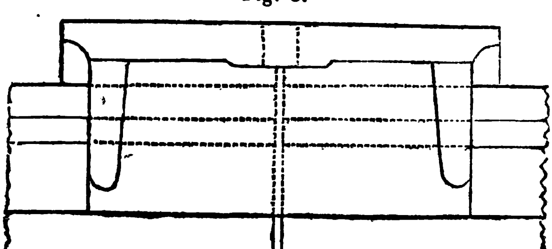


Fig. 4.

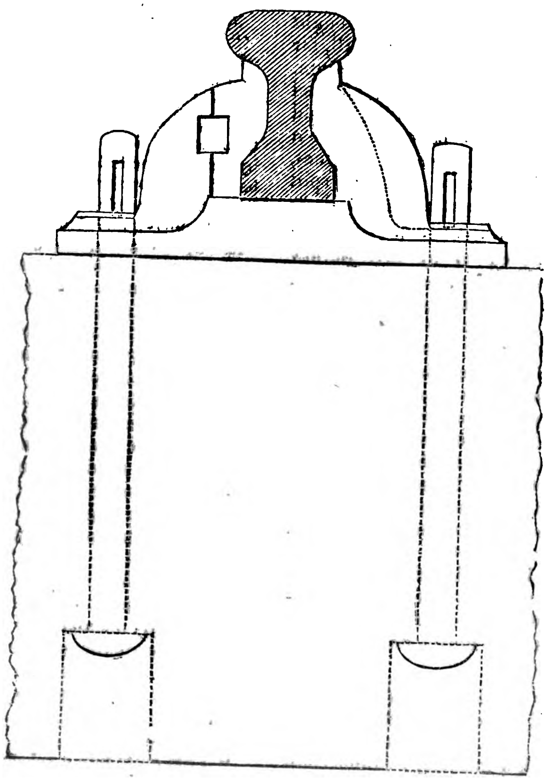
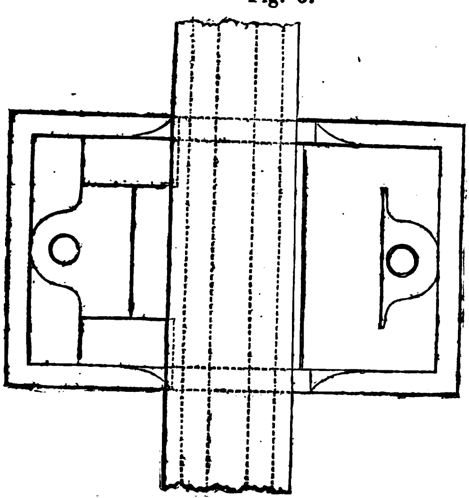


Fig. 5.



versant with railways, it must seem as inexplicable as surprising, that the lewis-pin method should have been thought worthy of favourable mention at all, far less of being honoured with a premium. Were such a mode of fastening adopted (as it, most assuredly, never will), it would not be long before the concussions from the passage of heavy locomotive-engines, at great velocities, would infallibly split the stone to the depth of the lewis.

The mode of fastening practised by me, and approved of by Mr. Barlow (though, strange to say, not treated with like favour by the Committee of Judges, of whom Mr. Barlow was one), consists, as will be partly seen from inspection of the figures, in inserting plain cotter bolts through the stone, and countersinking the hole up from the bottom for the space of an inch and a half or two inches, so as to permit the point of the bolt to drop below the base of the pedestal. I first tried screw-bolts, but was obliged to abandon them in consequence of the nuts getting, through corrosion, so fast to the bolts as to twist the bolt-ends off before they would unscrew. Fifteen years' experience has now satisfied me that the plain cotter bolt is the only one that will answer.

Mr. Barlow speaks of this method of fastening as if it were the suggestion of Mr. Vignoles. But how he should have fallen into such a mistake, I cannot comprehend; for it was not only fully shown in the models I sent in to the London and Birmingham Railway Directors, but the advantages of it were particularly dwelt upon in the letter which accompanied them. To place this beyond all doubt, I will here repeat those passages of my letter which relate to this point:—

"The pedestal for the joint I would particularly recommend to be fastened to the sleeper with cotter bolts; I would also prefer fastening all the intermediate ones in like manner, though they would answer to be well nailed in the usual way, but much better with cotter bolts, as you then derive the greatest effect from the parallel rail, by keeping every pedestal firmly down. If only nailed, this may prevent the intermediate pedestals becoming fulcrums, in which case the fibres of the upper surface of the rail are not called into tension in the same ratio with those on the under side of the rail, immediately between the pedestals, while the locomotive or any other heavy carriages are passing along the line."

Again:—

"I prefer the mode of fastening the pedestals with cotter bolts as by far the most effectual for general use; if even they have to be fastened with smaller bolts (say $\frac{5}{8}$ths diameter), more especially when they can be thus secured at as cheap a rate as if fastened by nails. The holes for the small bolts can be drilled through the stone sleepers for less than the large holes necessary to receive the wooden plugs; and the small bolt and cotter will only cost a trifle more than the nail and wood plugs, as both the bolts and cotters can be made by a machine for that purpose."

Mr. Vignoles, though he certainly did not suggest the use of the cotter bolt, has done me the honour to cause it to be adopted in the construction of the Dublin and Kingstown Railway, instead of the nails or spikes commonly used.

Mr. Barlow makes some very forcible observations (which, in noticing his pamphlet, you have judiciously transferred to your pages), on the importance of exact fitting and fastening; but to show you that all practical men have not been so indifferent to these matters as Mr. Barlow imagines, and indeed somewhat broadly insinuates, I will, with your leave, make another short extract from my letter to the London and Birmingham Railway Directors, which has an immediate bearing upon this part of the subject:—

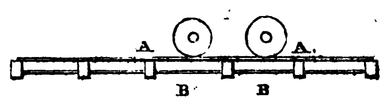
"I am quite sure a velocity of from 50 to 60 miles per hour may be obtained upon a well-constructed railway, with greater safety than one of 20 miles, upon any of the present lines yet in operation; not only from their having too tight a rail and ill-constructed pedestal, but from the mode of fixing them, *especially at the joints*, which is the great cause of so much deflection and sudden action, both vertically and horizontally—so that it is not in the power of man to make a locomotive-engine to stand the action they are subject to long together.

"I have frequently stated to Companies, that every public railway ought to be laid down as accurate and as firm as it is possible for hands to do them; and, when that is done, to put a steam-engine upon them to plane the surface, the same as we do our slide-rails."

I must also use the freedom to observe that, correct as Mr. Barlow's views are, of the importance of executing all railways in the best possible style of workmanship, he shows, in nearly all that regards the

details, great want of practical knowledge. Speaking of keying the rails to the pedestals, he says, that "if the rails and chairs must not be permanently fixed to each other by direct means, it ought not to be attempted by indirect means, viz. by cotter keys or wedges, for either these will hold the rail to the chair, or they will not; if they do hold fast, they produce all the mischief which permanent fixing would occasion; and if they draw, then they do no good, although they may still do mischief." Now, if the Professor ever had an opportunity of carefully watching for a summer's day the passing of heavy steam-carriages and long trains of other heavy carriages over a railway, he would never have ventured such a statement. He would have witnessed, that it is scarcely in the power of man to fasten the rails permanently to the pedestals. Aware of the impracticability of doing so, I do not allow the D key proposed by me (see fig. 1), when used to key the rail to the *joint*-pedestal, to be driven with more than a single-hand hammer; and I also stop it at its place when driven, the key being here merely intended to act as a steadiment to the rail. For before a locomotive-engine or heavy train has passed twice over the rails, the whole of the keys give or yield of necessity in such a manner as to allow the rails to expand or contract more than double what they really do, or are subject to, from the differences of temperature to which they are exposed. With respect, however, to the *intermediate* pedestals of the five-yard rails, the more soundly they are keyed to the rail the better, so as not to injure the pedestal by over-driving the key, as there is more latitude in the holes through the base of the pedestals where the bolts pass, than would compensate for treble the expansion and contraction the rails are subject to. Besides, each of the holes drilled through the stone blocks upon which the pedestals rest, is drilled $\frac{1}{8}$th of an inch larger than the diameter of the bolts, and the pedestals can never be so hard cottered down to the surface of the stone but what they will give a little. All difficulties on this head I got completely over several years back, in both wrought and cast-iron railways which have been laid under my direction. I could refer Mr. Barlow to several miles of railway which have been worked for years, and remain at present perfectly firm without the least distortion, either vertically or horizontally.

"Again: notwithstanding Mr. Barlow has actually proved by experiment that the parallel rail is superior to the parabolic, or fish-bellied rail, and has taken some pains to show the neutral axis, which has little or nothing to do with the best form of rail; yet he has forgotten to point out one of the most essential advantages which the parallel rail has over the parabolic rail, as I have frequently proved by the steelyard-lever. I have found that by holding the ends of the rails firmly down, at the joint-pedestal especially, the parallel rail of fifty per yard will carry upwards of a ton more, with the same deflection, than they will do if the ends are allowed to rise, which they will of course do, if the end-pedestals are merely nailed down in the bad and ineffectual manner hitherto usual, namely, by common rails or spikes. When the rails are kept firmly down by proper means, the intermediate pedestals become so many fulcrums, and the tension of the fibres of the upper parts of the rail is called into play; as will be readily understood from inspection of the following diagram, in which AA represent the points of tension, and BB the points of deflection.



I perceive further from Mr. Barlow's experiments, that he considers the best rail for strength ought to be from $4\frac{1}{4}$ to $4\frac{1}{2}$ inches deep, from the upper to the lower surface. I am quite confident, however, that it will be found that the best form of wrought iron rail ought not to exceed $3\frac{3}{4}$ inches deep, or 4 inches at most; for by making the rail higher, not only will the pedestal be much weakened, but there will be no possibility of holding the pedestals firm on their base, by cotter bolts or any thing else, more particularly at the shunts and curvatures of the line of railway, and even the stone blocks will be continually shaken. It is well known in practice, that the lower any rail and pedestal can be kept, the less is the destruction in them, and the less the action on the foundation upon which

the stone blocks are placed. It is also equally well known, that a sufficient wrought iron rail can be made of the depth I have stated, (namely $3\frac{3}{4}$ or 4 inches), to resist the action of a locomotive of 12 to 14 tons weight, at a speed of 40 or 50 miles per hour, (or even more if necessary,) if it is properly laid and adjusted.

I find that the different railway companies are now going to have their rails manufactured to weigh as much as 60lbs per single yard. The additional 10lbs per yard, ought, in my humble judgment, to be employed partly to strengthen the lower edge and make it to rest more firmly on its basis, and partly to increase the width of the upper surface; both in the manner shown in fig. 6, which is a sectional view of what I consider the best form of a rail of this weight. My object in these modifications, is to increase the adhesion of the locomotive-engines, as well as to give a little more bearing on the peripheries of their wheels, in order to make them last longer.

I understand the Directors of the Birmingham and Liverpool Railway (the Grand Junction), have recently given an order for one or two thousand tons of parallel rails, the upper and lower edges of which are both alike; and that they have been induced to give this form of rail a trial, by certain persons in their employment, who lay claim to it as *an invention of their own*, and puff it off (naturally enough), as superior to all others. Now, the fact is, that twelvemonths ago, I gave one of their engineers a set of drawings, of rails and pedestals, of a variety of forms, *and this was one of them*. And in my letter to the Directors of the London and Birmingham Railway, before quoted from, I also expressly made mention of this form of rail, as one that *might* be employed, but pointed out, at the same time, certain objections to its use, which restrained me from proposing it for adoption. My words were these:—

"I have hesitated with myself, whether or not to make a pattern with the upper and lower edges exactly alike, so as to be able to use either side, in case the former should prove a little unsound in any part, which has hitherto been frequently the case, especially at the ends, as I am fully aware that the more metallic material that can be brought to the lower side, adds considerable strength to the rails; but as you seem disposed not to exceed 50lbs per single yard, a little would be lost in the depth and height of the rail. Allow me to assure you, that no public railway company, will ever regret having sufficient strength in the rails at the beginning, and that they ought not, by any means, to confine themselves to a pound or two in the yard, in order to make the work as complete and substantial as possible at the commencement. But, as it is, after mature consideration, and taking every thing into question, I prefer the models I have furnished (Nos. 2 and 3), as the keys will be more effectual."

Fig. 8 is a section of the form of rail that I recommended, and would still recommend, for adoption where it is desired to construct it, so that it may be inverted if necessary. It is what I call a "fancy rail," but ought to weigh at least 55 lbs. per yard.

Fig. 8.

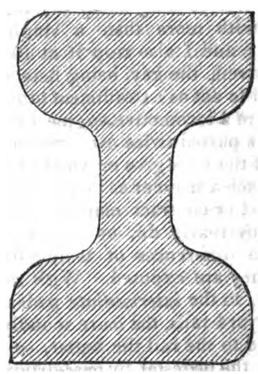
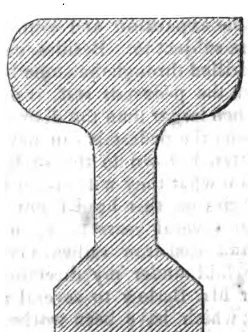


Fig. 9.



Where a railway is intended for locomotive engines of only from eight to ten tons weight, a rail of the form represented in fig. 9, and weighing only 45 lbs. per yard, will be found to answer sufficiently well.

For America, where they have great difficulty in obtaining stone blocks, and are in the custom of fixing their rails on wooden sleepers of lengths varying from 30 to 50 feet, secured by cross sleepers, the best form of rail is that shewn in fig. 7. I have been informed by American engineers that they can get plenty of a hard durable timber, very suitable for the purpose, for little more than the expence of cutting it down in the forests, and sending it to the saw mills to be cut into scantlings fit for immediate use; and that a railway bed of this description will last for nearly twenty years. Sometimes they lay their rails on cross sleepers only, dispensing with the side pieces. Several orders for rails of the form above referred to, are now executing under my inspection for railway companies in America.

But to return to our own country:—Mr. Barlow, I observe, says, "For the intermediate chairs, I think a slight modification of Mr. Stephenson's would best answer the purpose, that is, I would support the rail in the chair simply by the ends of two plain-ended pins, so as to give it the requisite steadiness with as little friction as possible. Of course I would have these pins pointing horizontally, or upwards instead of downwards, as they do in the chair in the question." The chair here alluded to is, I presume, that for which Mr. Stephenson, *junior*, sometime ago took out a *patent*, instead of submitting it, as might have been expected, to the test of the open competition, which his employers, the London and Birmingham Railway Directors, thought best for the interests of the public. As I have not myself seen any drawing or description of this chair, I am not prepared to offer any decided opinion upon it; but if its excellence consists (as Mr. B.'s language seems to indicate,) in supporting the rail, "simply by the ends of two plain-ended pins," it must be one of the most inefficient of all the contrivances ever designed for the purpose. Mr. B. might as well make use of two of his fingers, as two such "plain-ended pins;" for after a locomotive engine had passed once or twice over them, they would be (not crushed, perhaps) but rendered of no manner of use whatever.

Mr. Barlow says in a note to the passage last quoted, "It may be worth consideration, whether if this mode of fixing were adopted, it would not be practicable and advantageous to introduce pieces of felt, or other substance, within the seat of the chair, which would greatly subdue the jars that take place between metal and metal."

A crowning instance this, of the little practical acquaintance Mr. Barlow has with the subject about which he has written so learnedly. I have said that he might as well make use of two of his fingers as two of Mr. Stephenson, Jun.'s pins (if Mr. Stephenson's they be); and so I now take leave to tell him that as far as any benefit is to be derived from the insertion of felt within the chair, he might as well insert a piece of his thumb-skin.

I will only, Mr. Editor, trespass further on your valuable space, to make another brief extract from my letter to the London and Birmingham Railway Directors, which contains a suggestion for the further security of the rails that seems to me not undeserving of general attention:—

"I should also advise, that each joint-pedestal should be coupled with the opposite one by an extended round bar of $\frac{3}{4}$ths or $\frac{7}{8}$ths diameter, with a washer welded on each end, so as to drop on the ends of the cotter bolts in order to keep the railway in true guage. This I have found of great service even on common railways."

Trusting to the interest and importance of the subject for a justification of the length to which this letter has extended,

I remain, dear Sir,
Your's respectfully,
ROBERT DAGLISH.

Orrell Cottage, near Wigan,
May 26, 1835.

THE ROYAL EXCHANGE—ITS STATUES AND ITS EMPTY NICHES.

Taking a stroll the other day to this great emporium of commerce, I could not help noticing one or two great blots or blemishes, which are the result either of culpable neglect or of bad taste. From whatever source they may arise, they call loudly for amendment, or, at

least, animadversion. The interior of the quadrangle is furnished with twenty-four niches, or recesses, for the evident purpose of containing as many busts or statues of departed individuals whose private or commercial success may have rendered them deserving of so estimable a distinction. Only two of these niches are appropriated in accordance with the original design. One contains a statue of that noble and magnificent character, Sir Thomas Gresham, the founder of the Royal Exchange; the other, a full-length figure (excellently done) of the benevolent, patriotic, and much-respected Sir John Bernard. The remaining twenty-two niches are unoccupied, although sufficient civic worth has existed since the foundation of the structure to have filled them sevenfold. Even the little that has been done—the two statues of Gresham and Bernard—are half-shrouded from the view by the dust and filth which have been suffered to accumulate upon them. I have lately been in Holland, and was highly pleased to see the admirable state of cleanliness and preservation in which the Dutch keep the similar memorials of their illustrious men. Nor has even Royalty fared any better with us; for on turning to look at the statues of our Kings which "mock embellish" the upper part of the smaller quadrangle—from the fighting Edward the First to "Gentleman" George the Fourth—the begrimed, weather-worn, defaced, and dilapidated state of the whole is really very shocking to behold. Surely Royalty never, in its worst days, was at a greater discount. Were my late witty friend, Charles Lamb, alive, and a member of the Gresham, we might expect to hear of his making a motion that the portrait of "Dirty Dick" should be added to render the set complete. To revert, however, to the twenty-two vacant niches intended to be, but not filled, by eminent citizens—our *City* Kings, as it were—why should they any longer remain so? No lack is there of departed worthies from whom to make a suitable selection. Two I will myself take the liberty to name. The first (and the statue ought to be of "Parian marble") is that renowned citizen of London, Alderman William Beckford, who dared to utter truths in the ear of Royalty, which no courtly sycophants would ever have had the courage to disclose. The second is a man, the whole of whose political life was spent in a struggle for the people's rights, and yet who met with the rankest ingratitude from that same people when they had it in their power to reward him for his long and meritorious exertions in their behalf—need I name that upright magistrate, and most patriotic and consistent politician, the late Alderman Waithman?

ENORT.

Marlborough-terrace, Albany-road.

ON RAILWAYS. BY JOHN HERAPATH, ESQ.
NO. V.

It is surprising with what inveterate obstinacy some men oppose every thing new. It matters not how great or how obvious soever its utility be; if the measure be new, or out of the ordinary course, that is enough. "My father did so and so and did well, why should I do otherwise?" exclaims one. "Our ancestors had none of these schemes, and yet the nation was happy and prosperous," says a second. "Ah!" groans a third, "it is a sure sign of approaching ruin when schemers succeed, and the good old order of things is turned topsy-turvy." Is it not a pity that these perpetual grumblers, and admirers of olden perfection, do not examine some of the comforts they enjoy from the schemers of former days, before they give vent to their spleen against modern improvers? I figure to myself one of these gentlemen disappointed of his morning's repast from the daily papers, or of news he was anxiously expecting, because "printing, being found to throw numbers of industrious men out of bread who had subsisted by copying, was forbidden." I fancy I perceive another, now feeling his way through the dark streets with his stick, and now breaking his shins over baskets, &c. the blinking lights would not allow him to see, because it being "ridiculous to light London with smoke," as a sage observed, gas was discouraged. Lastly, I imagine I see a third reduced to distress for want of supplies from his foreign possessions, or, who having amassed a large fortune abroad from the salary and perquisites of an office with little duties to perform, was unable to return to enjoy it, because astronomical navigation has been "prohibited, it having grown out of Hipparchus's numbering the stars—"a deed,"

says one of the ancients, "of which God himself did not approve." It is a pity, I repeat, but that these opponents to every thing new, would look a little further into the advantages they derive from the progress of improvement, before they venture to mar undertakings of great public and national utility, or to stir up to such measures, an opposition, which is to saddle the promoters with thousands on thousands of expense,* and even their own posterity with a perpetual tax. We should then have many samples of such truly English conduct and sentiments as the following, which richly deserve to be set up in both Houses in capitals, with this for a preface—"READ, MARK, LEARN, AND INWARDLY DIGEST:"—

"Your design," said Mr. Alston, M.P., at a railway meeting I attended the other day, "is to carry your railway through my park. By this means you will spoil property and a house of some centuries standing, on which large sums have been expended, and which it is certainly my wish to leave to my son, who is here, uninjured if I can. However, I know for a railway you must have a good level, and that the line you have chosen is the best you can have. I also know, that private interests like our's should give way to public good; and I, therefore, come to tell you, only pay us reasonably and fairly, for the injury you do our property, and we shall not oppose you or give you any trouble."

On the Motive-Power of Locomotive-Engines.

Every one knows that the principles of motion in locomotive-engines, are, the force of the steam on the piston to turn the wheels, and the resistance of the materials on which the wheels roll, to prevent their sliding or slipping round. It is, therefore, the excess of the steam-power to turn the wheels above the slipping resistance, which generates progressive motion; and the amount of this resistance, which measures the intensity of traction, or determines the weight that can be drawn. Hence friction—that enemy to ideal perfection in machinery, and stumbling-block to the wanderers after perpetual motion—becomes here our best coadjutor; where fools see an enemy, the wise often find a friend. Without friction, indeed, the almost omnipotent power of steam would be useless and valueless.

The amount of slipping friction, or, as I shall hereafter call it, the bite of the wheels, is, between the same materials, in proportion to the weights. According to some experiments I witnessed on the Runcorn and St. Helen's Railway, it is about $\frac{1}{10}$th of the total weight, in a medium state of the rails. An engine, therefore, of 10 tons, duly supplied with steam, will exert a horizontal pull of $10 \times \frac{1}{10} = 1$ ton, supposing all the wheels to be acted on by the steam, or coupled together. Consequently, if the rolling friction be, as generally stated, $\frac{1}{240}$th of the load on railways, the weight which a steam-engine of 10 tons could draw, including itself, along a horizontal railway, would be 240 tons; or, every engine could draw $\frac{1}{10} \div \frac{1}{240} = 24$ times the weight on the working wheels. But it will perhaps be more satisfactory to put this in general terms, and show from the experiment alluded to, the amount of the bite.

Let $b =$ the bite on a level plane.
$t =$ the force of traction on ditto.
$z =$ the angle of inclination of any plane.
$w =$ the weight on the working wheels.
$W =$ the weight of load and engine.

Then $bw =$ the total bite or force of traction when the engine is doing its best on a level; and $bw \cos z =$ the same in an inclined plane. But $Wt =$ the force of traction on a level due to the rolling friction; and $Wt \cos z$ that on the inclined plane. If this, therefore, be augmented by the effect of gravity $W \sin z$, pulling the load down the plane, the sum $Wt \cos z + W \sin z$, is the force of traction wanting to maintain motion up the inclined plane; and, consequently,

$$bw \cos z = W(t \cos z \pm \sin z) \quad (5)$$

Now, if the inclination was 1 in 23, or near 230 feet per mile, the error of making $\cos z = 1$ would be less than 1 in 1000; and, therefore, for all practical purposes, we may safely assume $\cos z = 1$, which reduces the expression to

$$bw = W(t \pm \sin z) \quad (6)$$

* I have heard that it cost the Birmingham Railway Company about 96,000*l.* to obtain their Bill, which is a perpetuity of 3,840*l.* per annum at 4 per cent. The Great Western, it is said, will not obtain their's under a much greater sum.

By knowing any four of these quantities, the fifth may be found. For instance, the greatest multiple of the weight on the working wheels, which can be kept in motion on a horizontal plane, is $\frac{W}{w}=\frac{b}{t}$; and the greatest inclination which can be ascended is found from $\sin z=\frac{w}{W}b-t$.

The general estimate of the force of traction on a level railway is 9 lbs. to a ton; but Mr. Dixon told me he thought it approached nearer to 10 lbs. If, therefore, we take $9\frac{1}{3}$ lbs., which gives $\frac{1}{240}$th, the usual estimate, we cannot err much. This being settled, the following experiment, before alluded to, on the Runcorn and St. Helen's Railway, April 11, 1834, will afford us the means of determining the value of the bite:—An engine called the "Director," $9\frac{3}{4}$ tons, with coupled wheels, dragging her tender $3\frac{1}{2}$ tons, and two waggons of coal $13\frac{1}{2}$ tons, started from a little way below the commencement of a plane rising for some distance from the bottom 1 in 30, and near the top 1 in 26. On the engine were two men, and on the tender myself and two others, as far as I remember. One of the men held the escape-valve firmly down, which enabled us slowly to reach the summit; but it was evidently a maximum effort. Presuming the weights and inclination to be right, we have $W=9\frac{1}{4}+3\frac{1}{2}+13\frac{1}{2}=26\frac{3}{4}$, $w=9\frac{3}{4}$, $\sin z=\frac{1}{26}$, and, as before, $t=\frac{1}{240}$. Consequently,

$$b=\frac{26\cdot 75}{9\cdot 75}\left(\frac{1}{240}+\frac{1}{26}\right)=\frac{1}{8\cdot 55}.$$

But, if we suppose the two waggons to be only 10 tons, no more than which, I have since been assured they were, $W=23\frac{1}{2}$ and $b=\frac{1}{9\cdot 84}$, or, in round numbers, $\frac{1}{10}$th, which I have reason to believe is a reasonable estimate of the bite. It also agrees very nearly with another experiment on the Sutton inclined plane I attended with the "Etna" engine, and with the celebrated exploit of the "Sampson," weighing 9 tons, 17 cwt., with coupled wheels. This engine being helped up the inclined planes, once drew 223 tons, at 12 miles an hour, from Liverpool to Manchester. Now, 9 tons 17 cwt. $\times\, 24=236\frac{1}{2}$ tons, from which deducting 10 tons for the weight of the engine, leaves $226\frac{1}{2}$ tons for the load, only about $3\frac{1}{2}$ tons above what the engine drew.

Hence, if $W=w$ we have $\sin z=b-t=\frac{1}{10}-\frac{1}{240}=\frac{23}{240}=\frac{1}{10\frac{1}{2}}$ nearly; that is, the maximum inclination which a locomotive-engine could ascend without any weight attached, having coupled wheels, and in a medium state of the rails, would be an ascent of about 1 in $10\frac{1}{2}$.

This bite varies much with the weather and state of the rails. Generally, the upper surface of the rails is covered with a thin coating, compounded of dust and oxide of iron, presenting in dry weather, that iron glassy appearance which we see where horses have slid about in the London streets; and which, at first view, impresses one with the idea, that such a surface could furnish but little hold for the wheels of the engine. However, in dry weather, the coating is hard and firm; and though I suspect the bite is then not so great, yet as the surface is at the time smoothest, the rolling friction is probably a minimum, which makes up for the difference, and causes the rails to work so well. In very wet weather the coating is perhaps nearly washed off, or so liquified, as to permit the surfaces of the wheel and rail to come into immediate contact. By this means the bite may be somewhat augmented, and probably, the friction too, by the imperfect liquefaction of the coating. These two circumstances combined, may be the cause that in very wet, or very dry weather, the rails work equally well. But when a little wet has weakened, without destroying, the tenacity of the coating, it will form a series of rollers like grease between the wheel and the rails, thereby diminishing the bite, while yielding to pressure, it will present a continued obstruction to the wheels, and hence increase the rolling friction of the train. In this case, the effective action of the engines will be extremely enervated; and, of course, the velocity of the train considerably impeded. I was informed the trains had, in this way, been occasionally reduced to a stand-still, when ascending the inclined planes. In one instance, I myself saw two engines with seventeen loaded waggons creeping up

the Whiston plane, after a little wet, at a rate of scarcely three miles an hour; and if it had not been for two men seated on the front arms of the first engine, dropping sand incessantly on the rails before the engine, it appeared evident to me they could not have gone up at all. I also observed, that the trains invariably travelled much slower, and with more difficulty, early in the morning, before the dew was off, than later in the day. The difference in the time of transit amounted to a quarter of an hour or twenty minutes, though the loads were very nearly the same, and the slower train had the advantage in point of road, that is, in going from Liverpool to Manchester, which is easier than from Manchester to Liverpool.

I hope I shall be pardoned for saying so much on this part of the subject; but it is one of such paramount importance in the mechanical operation of railways, that I could not lightly permit it to pass. Next to the improvement of the engines, it demands the deepest attention; for it is lamentable, that a heavy dew, or a little rain which would scarcely lay the dust, or a little snow which would disappear the moment it fell, should be able to paralyze one of the noblest of modern inventions. A remedy, I think it would not be difficult to find. Should I ever be connected with the construction of a new railway, I intend to try one, unless before-hand, a better should be in use.

By what has been shown, it is evident that the first principle of locomotion is the hold or bite of the wheels on the road. Unless this exceed the amount of traction force, steam-power is thrown away, the wheels will slide round, and no motion can ensue, or be kept up after it is attained. When the bite is ample and the steam turned on upon a stationary engine, its want of vent rapidly raises the temperature of the boiler, and, consequently, the quantity and pressure of the steam on the piston. A gradually increasing motion is the consequence. But as this motion increases, so do the strokes of the piston and consumption of the steam; and it results, that the temperature of the boiler sinks again, until it has reached that point at which the temperature carried off by the consumed steam, balances that communicated by the fire to the boiler. At this point, a uniform motion in the train will commence, and be maintained, without any regard to the bite of the wheels being in excess of the traction of the load. An engine of a less weight will therefore preserve that velocity it could never have given. However, it will, in all cases, be advisable to have more bite than is wanting; especially as the expense of propelling an additional ton or two is immaterial, and might always be made up in the structure of the carriages of the train. Objections I know arise to weighty engines, but where the question is one of efficiency or inefficiency, there is little room for choice. I would much rather increase the strength of the rails, which, wearing but little, will be thrown chiefly on the first cost, than be deficient in that which is indispensable for success, namely, power in the engine.

A very important consequence in the structure of a railway follows what we have said, but which has been strangely overlooked in some of the projected railways. I allude to elevating the main, and intermediate termini of a railway, above the general lines in their respective neighbourhoods, so as to begin with a descent from every point of rest. By this means, gravity may be pressed into service in aiding to get up the full speed quickly with departing trains, while with arriving trains it would be scarcely less beneficial in arresting their velocity. As the engines commonly labour and strain more at starting than in other parts of their course, this is the place at which, on the principle of economy as well as on account of the speed, it will be most advantageous to assist them. On the Liverpool and Manchester line, this object has been pretty well accomplished at the two extremes, but whether by accident or design I am unable to tell.

The present number having been extended to a greater length than I intended, I must reserve the mathematical consideration of the subjects just now discussed, to a future communication.

Another point, of scarcely inferior importance, also suggests itself from our views of the necessity of having ample bite, namely, that of making all the wheels of the engine efficient, or of applying the

steam to them all, instead of to two only, as is commonly done. In some engines the two hind wheels are fixed to the axle, to two cranks of which, in perpendicular planes, are applied rods from the pistons. In others, strong bars also go from each hind, to its corresponding fore wheel; thus tying, or coupling them together, and making all four do their duty on the road. Among practical men, considerable difference of opinion exists as to the respective merits of these methods. Mr. Dixon and Mr. Roberts, of Manchester, gave me their opinion in favour of uncoupled wheels. Coupled wheels, one of these gentlemen thought not so well adapted for quick work as uncoupled; and both allow, that they are much more likely to get strained, and out of order. On the contrary, others, and among them a gentleman who has several of his engines at work on the Liverpool and Manchester Railway, expressed to me a decided preference for coupled wheels. Mr. Dixon made an observation, which, coming from one of his extensive opportunities of acquiring correct practical knowledge, is deserving attention—he thought that uncoupled wheels have as much power for rapid motion, as, in the present state of our steam-engine skill, steam can be found for. Admitting this, would it not be advisable to reduce the weight of the engine, so as to ease the rails of the great stress on them, and contrive some means of applying the steam to all four wheels without creating that strain which is complained of? Not knowing whether it has been tried, it has occurred to me, that if the fore and hind axles were similarly cranked and coupled, with strong carriers (as Mr. Gurney would call them) on their shoulders, which were made to act against a bolt in the interior circumference of each wheel, the wheels might turn like other carriage-wheels, freely on their axles, and obviate much of the straining of wheels immoveably tied to each other and to the axles, while each would do its portion of the work.

JOHN HERAPATH.

Kensington, June, 1835.

M'CURDY'S PROPELLERS.

Sir,—Had Mr. M'Curdy been a little more explicit in his account of his propeller, he would have saved both himself and me some trouble, and have prevented any misunderstanding. In his description he does not state that his cranks are to be of *cast*, and not *wrought*, iron; and the latter being the material of which they are generally made, it was but reasonable for me to suppose that he followed the usual course. Allowing therefore, the advantage in point of cheapness of cast cranks over wrought, and of "one pattern serving for all," (vessels of all sizes?) I have only to observe, that there is quite as much uncertainty in producing a perfect casting, as a perfect welding; and that as wrought iron is flexible and tough, and cast the contrary, (according to Tredgold's experiments, the specific cohesion, taking glass as one, of the best German bar, is 9.880, and of the best German cast, 7.250,) what is wanting in strength, must be made up for in bulk, and consequently weight. Nor has he disproved the inutility of using a number of cranks, which being able to act only in unison, the derangement of one would interrupt the working of the others. If, for instance, the paddle arm or rod B, were to receive an accidental blow or shock, so as to bend it, this would render the action so stiff, as greatly to impede the working, if it did not derange or break the whole apparatus.

Mr. M'Curdy is altogether mistaken in imagining that my remark upon the originality of the invention, was intended as "a sneer;" or that by that remark, I intended to attack the validity of his patent. I did not even know that the invention was patented. He does not so state in his description (No. 607). I merely meant to infer that any constant reader of the Magazine would recollect, that paddles on nearly the same principle had been proposed and described several times in it, and that it would be unnecessary for me to repeat such descriptions. I had in view, Chandler's paddles, vol. x. p. 289, and more especially the plan proposed by "Robinson Crusoe," vol. v. p. 201.

The principal point in Mr. M'Curdy's propeller is, the placing the cranks at different angles, which produces a quick succession of dippings of the paddles; this has been adopted by Stevens—the

only difference being that M'Curdy's is a four-throw, and Stevens's a three-throw.

I have, it will be perceived, spoken of "Fair Play," as Mr. M'Curdy. Indeed, it must be evident to every one, that the defence of his propellers, was either written by him, or to his dictation. But this does not, in the least, alter the strength of the arguments.

I am, Sir, &c.

SCRUTATOR MECHANICUS.

June, 1835.

A WORD OR TWO FOR MR. PINKUS.

Sir,—There is a practice amongst some men who are scientific, or pretend to be so, that cannot be too severely censured. It is this:—whenever a plan in the arts is proposed that bears the stamp of originality, there are some persons always ready to pounce upon the project and lay claim to its invention. You will generally find, upon inquiry, that those persons have standing caveats at the patent offices, with cunning titles, suited to any thing they may choose to adapt them to. I have several times, in the course of my practice as an engineer, met with the most glaring instances of fraud of this kind; provision ought to be made against them in any new patent law that may be framed.

My attention has been drawn to this subject, by a letter in your 617th number, from *Macclesfield*, claiming whatever merit there may be in the pneumatic railway. The writer shows by his letter, that he is not well informed on the subject, and that his ideas about getting a power by forcing air through a long pipe, are altogether fallacious. It has long since been proved, that we cannot get power and speed in such manner; the friction would annihilate the whole of the moving force employed. It is well known, however, that when air in a pipe is rarefied, the effect is entirely different. Besides, Mr. Pinkus has a mode, by means of fixed valves, of regulating the length of the column of air, as practice might require. In looking at that gentleman's published specification and diagrams, I see that he understands the subject that he is upon, and has provided the means of carrying his plan into effect. It is true, that Mr. Pinkus must remove all the air before his piston, but then he has not to do that all at once. He does that by keeping up the rarefaction between the valves;—the larger the pipe, the less the degree of rarefaction of air,—the smaller the pipe, the higher the degree. Within certain limits, the same power would act in both alike. Your other correspondents on the pneumatic railway have committed some great errors, which I will, at another time, point out.*

Now, as to the originality, I happen to know that the principle belongs to Mr. Pinkus, because in the early part of the year 1825, I was employed by that gentleman to make a perspective and sectional drawings of a plan for propelling, which he proposed by means of a *pipe* to be laid along a railroad, and by the side of a canal, through which he intended to pass a current of STEAM, instead of *air*. The pipe had a narrow slit or opening on the side or under side, which was closed by a flexible valve, acting from the inner side, and which was closed by a wheel, and kept tight by the pressure of steam: the pipe had a jacket through which hot water or steam was to circulate, so as to prevent the steam in the pipe from condensing. The steam was to be let in at every mile or two along the line, from boilers or steam generators. This was certainly a pretty idea, but I know that the inventor was the first to point out its fallacy, on the ground of the impossibility of getting a power either by forcing *steam* or AIR into, or through a long pipe, because the greater the *pressure* of the steam or *compression of the* air, the greater the *friction and retarding force;* to say nothing of the great loss from constant radiation of heat, condensation of the steam, and vast quantity required. Moreover all the joints must be tight, in proportion to the pressure, or the loss would be

* We shall be happy to hear again from our correspondent, and hope he will then show a little more clearly than he has done here, *how* Mr. Pinkus has actually "provided the means of carrying his plan into effect." We do not, of course, refer to the pecuniary, but the scientific means.—ED. M. M.

great in proportion to such pressure. So much for the originality of your Macclesfield correspondent. Mr. Pinkus began his patent for the pneumatic railway in 1831, as I see by a notice from the patent-office now before me.

I shall be glad to see this statement printed in your Magazine, to which I have been a subscriber some years, in the usual fair manner in which you print the pro's and con's.

Your obedient servant,
H. C. SEXTON.

Chatham, June 13th, 1835.

THE BUTTERLEY COMPANY AND HOT-AIR SMELTING PROCESS.

Sir,—I have to request you will correct an error in No. 614 of the Mechanics' Magazine, in which the *Birtly* Iron Works, near Newcastle, are confounded with the establishment of the Butterley Company, who are proprietors of the Butterley and Codnor Park Iron Works, Derbyshire. This company has been formed for half a century, and possesses an almost inexhaustible field of the finest minerals. Coals they send off in large quantities for sale in all directions, by the various inland navigations, communicating with the Trent, the Soar, &c. &c., untill it meets the sea-borne coal; and at least ten different beds of iron ore, all lying in the immediate vicinity of the furnaces, are now in work for their supply.

The Butterley Company employ in their mines, coal-fields, blast-furnaces, rolling-mills, forges, boring-mills, and steam-engine manufactory, 35 steam-engines of all sizes, from 80 inches of diameter of cylinder, and have six blast-furnaces, of which four are now in work. The whole of these furnaces are blown with heated air, and the coal, which is admirably adapted for the purpose, needs no cokery, being very carbonaceous. The mountain limestone, which lies but three miles from the furnaee, is used as flux for the ore, which is clay ironstone. These materials produce a very fine grained cast-iron, remarkably soft and fluid, and at the same time, they are equally well adapted to make "forge pigs," from which are manufactured bars, hoops, and boiler plates, of the best quality, and steam-engines. But, as your correspondent observes, that much prejudice exist against iron made from heated air, I shall have much pleasure in sending you specimens of the iron, both wrought and cast for inspection. M. Dufresnoy, M. Perdonnet, and several other Frenchmen of scientific reputation, have visited the Butterley Company's Works, with which they have been highly pleased, and have been willing to communicate the valuable information they possess, in return for such as was afforded them here.

I am, Sir,
Your most obedient servant,
JOSEPH GLYNN.

Butterley Iron Works, near Derby,
June 18, 1835.

REPORTS OF THE COMMITTEE OF SCIENCE AND ARTS OF THE FRANKLIN INSTITUTE.

(Abridged from the Journal of the Franklin Institute.)

1. *Woodside's Revolving Harrow and Seed Cart.*

The committee having examined a model of the machine, and inspected numerous certificates of its performance, which have been given by agricultural gentlemen, are of opinion that this is a valuable improvement in that necessary implement of husbandry, the harrow.

Some of the committee were present during a trial of one of these machines, the result of which was highly satisfactory. It seemed on that occasion to require more power to move it than the common harrow; but its superior efficacy in eradicating weeds, and pulverizing the soil, will, it is believed, more than compensate for this difference, as it will certainly do more work at one operation, than the common harrow will at two or three.

Another advantage which it possesses, is, that it is not so liable to be clogged or choked by weeds, and clods of earth, as the common harrow. These are collected by the latter; and wherever the harrow is raised to clear it of them, there remains a heap of rubbish, which impairs the evenness of the field, and injures the crop.

The committee have not had an oppor-

tunity of seeing the seeding apparatus in operation; but from an inspection of it, they believe it will be found to answer very well for smooth and heavy seeds, such as clover seed, and wheat or rye, as it will, if properly regulated, distribute them more evenly than can be done by hand.

Subjoined, is a description of the machine, which has been furnished by the inventor.

Description of Woodside's Revolving Harrow and Seed-Cart.

"In the construction of my harrow I use a cylinder of about six inches in diameter, made of any solid wood, equal in length to the distance of from face to face of the hubs of the wheels of a cart, to which it is attached. The cylinder moves on gudgeons, passing through the arms of a frame, the four ends of which rest on the end of the iron axle projecting beyond the hubs. This frame is forced back from the cart wheel by a nut on a bolt, which enters the end of the arms of the frame, for the purpose of tightening the chain band, which passes over the band wheel, secured to the spokes on the inner side of the cart wheel, having a V groove to receive the chain. Near each end of the cylinder is a cast iron cylinder, with a V groove of about eight inches diameter, in which the chain plays with a cross, which gives the cylinder a counter motion to that of the cart wheel. The circumference of the band wheel on the spokes of the cart wheel being about 128 inches, and that of the cylinder wheel 24, gives six revolutions of the cylinder to one of the cart wheel; consequently, the teeth on the cylinder (39 in number) move with a rapidity which roots up all kinds of weeds, such as crab grass, wire grass, vines, &c., and, at the same time, pulverizes the earth most effectually, to the depth of six inches or more, the length of the teeth. By placing the chain band over the wheels, without the cross, the cylinder will, of course, revolve with the cart wheel; and as it makes six revolutions to one of the cart wheel, the cylinder, weighing 250 lbs., acting as a roller, tends to mash the clods of earth, which the teeth in revolving cut and lighten up, in a very effectual manner. In working the implement without the cross in the band, it does not require much power, but it is evidently not so effectual in destroying weeds, &c. There is a contrivance for elevating the harrow or cylinder, for passing over stumps, &c., by means of a windlass. The grain is distributed from the cart by a sieve of sheet iron, in the form of two spouts, having a descent each way, from the centre of the cart in front, and passing under the shafts, extending as far out as the cart wheels. To these spouts, or sieves, which are perforated to suit the size of the grain to be sown, is connected a mouth-piece of leather, in the upper end of which is a square frame of iron with a bolt, which bolt enters the front board of the cart, and suspends the sieve. A hopper, with a leather mouth-piece, placed inside of the cart, conveys the grain to the sieve, which is always full while any grain is to be seen in the hopper. The grain is shaken through the sieves by means of a cog wheel, which strikes the ends, and are revolved by a band which passes over the hubs of the cart wheel, and the two cog wheels on each side of the cart. The faster the cart moves, the faster the grain falls; and the quantity to be sown to the acre, is regulated by the number of holes in the sieves.

"The harrow and seeding apparatus can be attached to, and detached from, the cart in five or ten minutes, so that the cart is always at service for other purposes.

"I am willing to admit that my mode of harrowing requires more power than the common harrow, and I think my harrow is richly deserving of more power, as it does the work far, very far, superior to the implement heretofore used for that purpose. As regards the common harrow, I consider it a very rough, inefficient affair, which merely scratches two or three inches of the surface of the earth, covering the clods, but not breaking them; this has been fully proved, by passing my harrow over after it. I am fully persuaded that with three horses, and one hand, I can do more work than six of the old-fashioned harrows, and in better style."

2. *Baldwin's Locomotive Engines.*

The committee having examined several of these engines, which are now being built in Mr. Baldwin's workshop (Philadelphia), and find in them numerous im-

provements, affecting nearly every part of the machine. The first they will notice, are in the position and construction of the force pumps, which supply water to the boiler; the guides of the piston rods are made hollow, and the cavities are used for the chambers of the force pump, thus giving additional strength to the guides, without much increasing their weight, and dispensing entirely with the frame and fixtures of the ordinary force pumps. Each of these pumps is furnished with five valves, three of which are situated between the boiler and the piston, and two between the piston and water tank. The valve nearest the boiler is loosely swivelled to a stem, passing through a steam-tight collar in the top of the valve box, by means of which the valve can be sounded, and, in most cases, freed from obstructions.

The other four valves are contained in one box; this box is secured to the pump by a stirrup, which can be removed by loosening a single screw, so that the valves can be taken out, cleansed, and replaced, in a few minutes. By thus increasing the facility of examining and cleansing the valves, and thereby diminishing the liability of the force pumps to obstruction, the supply of water to the boiler will be rendered much more regular and certain; and the chief cause of those fearful explosions incident to steam-engine boilers, will be in a great measure removed, as it is confidently believed that these accidents are generally the result of a deficiency in the supply of water.

Another improvement consists in the manner of reversing the motion of the steam valves. This is done in the English engines by means of a treadle, and a series of levers, which move the eccentrics laterally on the propelling axle, after the hooks of the eccentric rods are thrown out of gear with the rock-shafts. In Mr. Baldwin's engines, the arms of the rock-shafts extend on opposite sides of the fulcrum, and each eccentric rod is furnished with two hooks, turned in opposite directions, so that it may be geared to either arm of its rock-shaft; the eccentrics are fixed immovably upon the axle, and the eccentric rods, instead of being carried (as they usually are) to the front of the engine, are brought to the stage at the hinder part, and there geared to either arm of the rock-shafts, at the option of the engineer. When the hooks of the eccentric rods are geared to the same arms of the rock-shafts as the valve rods are, the motion of the valves corresponds to that of the eccentrics; if they be geared to the opposite arms, the motion of the valves will be reversed; and if they be not geared to either arm, the rock-shafts and steam valves can be worked by the hand levers. The advantages of this arrangement are several; the eccentrics being firmly secured to the axle, are less liable to get loose, and out of repair; it dispenses entirely with the treadle, and its appendages, and also with four rock-shafts, and the complicated hand gear of the English method.

But the most important benefit is, that the rock-shafts and eccentric hooks are placed immediately under the eye, and within the reach of, the engineer, which is not the case in the ordinary arrangement.

The axle of the driving wheels has also been made the subject of improvement by Mr. Baldwin. Instead of fixing the ends of the axle into the centres of the wheels, as is usually done, he dispenses with one of the arms in each crank, and fixes the wheel upon the wrist of the crank, with its centre adjusted to the centre of the axle. By this change in the form of the axle, the power of the engine is applied directly to the wheel, without the intervention of an arm of the crank, thus diminishing the strain upon the axle, and, consequently, lessening its liability to be broken. By this means, also, Mr. Baldwin has, in some measure, obviated the tendency of the driving wheels to twist upon the axles, and become loose; a very general and troublesome defect of locomotives. Another good effect resulting from this change, is, that the distance between the two cranks is increased about ten inches, which will admit of a corresponding enlargement of the boiler, and of a more advantageous disposition of the weight of the fire-place, by bringing it about fourteen inches nearer to the axle. In these engines, the steam pipe is introduced into the boiler through the opening by which it usually communicates between the dome and the cylinders; and the end of the pipe beneath the dome is supported on a horse, fixed within the

boiler, so as to admit of its longitudinal expansion and contraction by changes of temperature; and to avoid inconvenience from the same cause, the stop of the throttle valve is fixed on the steam pipe, instead of the head of the boiler. A twofold benefit is derived from this plan of introducing the steam pipe; first, the pipe may be made without a joint within the boiler; and secondly, a man hole in the boiler may be dispensed with; for the juncture between the dome and boiler, as well as all the other steam joints, being accurately fitted by grinding, and formed without any cement, or packing, the dome can easily be taken off and replaced, and its aperture used for occasional access to the inside of the boiler.

In the construction of his driving wheels, Mr. Baldwin uses hubs and spokes of iron, cast in one piece: felloes of hard wood are framed into the ends of the spokes, and the whole is firmly bound together by a stout tire of wrought iron, with a flanch on its inner edge; thus, by a judicious combination of iron and wood, he has united the strength and firmness of the former, with the elasticity of the latter, so desirable in the tread of the wheels.

Mr. Baldwin has completed several engines, which combine all these improvements; one of them may be seen in operation on the Philadelphia and Trenton Rail-road, and four on the state road to Columbia; all of which, as well as one in use at Charleston, South Carolina, have given entire satisfaction by their performance.

3. *Tyler's Shifting Gauge Cock.*

This gauge cock consists of a tube, with a long, sweeping bend, which passes through a steam-tight collar, or socket, in the head of the boiler. When this tube is made to revolve in its socket, the motion of the end in the boiler corresponds to that of a radius from the centre of the socket; so that, if its radial length be six inches, the orifice will describe a circle three feet in circumference, and command a vertical line in the boiler, one foot in length. The lever which turns the plug of the cock outside of the boiler, has, when it is parallel to the head of the boiler, the same radial direction and length as the tube within; so that, when applied to the head of the boiler, it will always indicate the position of the inner orifice of the tube.

The utility of this contrivance is obvious at a glance, as a momentary inspection will show that, by means of it, the elevation of the water in the boiler, and its condition, whether of increase or decrease, can be ascertained with the greatest accuracy. It also possesses the merit of simplicity, and fitness for practical application, and will generally enable a prudent engineer to avoid the danger arising from a deficiency of water in the boiler.

RECENT AMERICAN PATENTS.

(Selected from the Franklin Journal.)

Machine for Adding, *Daniel Kohler, Sunbury.*—In the "*Machines Approuvées par l'Academie Royale,*" there is a considerable number described for performing operations in arithmetic, and we could point to many others of more recent date. Judging, however, from the universal fate of such machines, we conclude that they have generally led to the road "round Robin Hood's barn," for we have never seen one, excepting in the collections of some learned societies, where they are deposited as articles of curiosity. We are apprehensive, therefore, that the present patentee has expended a portion of thought and money upon his contrivance, for which he will never be rewarded, either in pelf or in fame. The machine operates by means of wheels and pinions, and the sums added are pointed out by indices. We do not think that we should perform a service acceptable to our readers, by attempting a description of it, more especially as the patentee has neglected to tell in what particulars its novelty consists, having made no claim, and the whole affair being treated as though the Abacus and Babbage's machine, with all the contrivances intermediate in merit and in time, had never existed.

Improved Mode of Manufacturing Oakum, *E. Cook and S. Usher, Connecticut.*—Oakum, it is remarked, has hitherto been manufactured from old junk, or rigging, or from new rigging, or yarns spun and tarred for that purpose; but the patentees state that they have discovered that the requisite quantity of tar can be incorporated with the fibres of tow, hemp, or flax, without the necessity of previously spinning it. The process consists simply in immersing the materials in a kettle of heated tar, and expressing the superfluous portion in a press of any construction. The patentees broadly "claim as their joint discovery and improvement,

the principle that the proper quantity of tar can be incorporated with the material of which oakum is intended to be made, whether hemp, flax, or tow, in its dressed state, without first twisting or spinning the same; whether effected in the mode aforesaid, or in any other manner."

We are not aware that this mode of preparing oakum has been practised; but from the simplicity of the process, and the extensive use of the article, it scarcely seems probable that it has not been essayed.

Block Printing, *James Rennie, New Jersey.*—Two Patents:—1. For supplying and diffusing the colour. A wooden trough, rather more than twice the size of the block to be used, is made to contain the colouring matter; a second trough of tin, copper, or other metal, occupies one-half of that first named, the centre of its bottom having a hole through it of one-fourth of an inch diameter. The colouring matter is poured into that space in the wooden trough not occupied by the metal one, and flows thence through a hole in a partition dividing the large trough into two parts, so as to pass under the metal, and up through the perforation in its centre. A sheet of sponge, or similar material, is to be placed upon, and to cover the bottom of the metallic trough. and upon this the sieve, used in such printing, may be placed. The height of the liquid poured into the first trough, with the degree of its fluidity, &c., will determine the rapidity with which it will be supplied to the sieve, and this, therefore, is capable of being properly regulated. 2. An improvement in the above apparatus by which two or more colours may be printed at once. The space occupied by the horizontal plate on which the sponge, &c. is to be placed, as before described, is to be divided into two, or more, compartments, by vertical, metallic partitions; and each of these compartments is to be supplied with a separate colour, by the means before set forth. The block with which the printing is to be effected, is to be so constructed that it will span these partitions, and allow the different parts of it to dip into the respective colours. "By applying the type, form, or block, to the sponge, or sieve, within the spaces, the different colours and shades will be communicated to the appropriate parts, and may then be stamped, printed, or impressed, on the cloth, paper, or the material to be printed, at one impression."

Manufacture of Glass or Sand Paper, *Isaac Fisher, Springfield, Vermont.*—Four Patents:—1. For sizing and distributing the glass upon the paper. The main things claimed are the steaming the paper on the unsized side, which prevents its curling; and the manner of distributing the glass upon the sized surface, which is done by laying the paper upon an endless feeding apron, and passing it under a sieve constructed for the purpose, which sieve vibrates in a close box over the paper. 2. For softening the glass paper. In the machine for this purpose, the paper is made to pass between steel rollers, of which there are five; three of them stand horizontally, and in the same plane, and two others beneath them, with their gudgeons intermediate between the upper rollers. The glass paper is laid upon a cloth, which passes between the upper and the lower rollers, and traverses once backward and forward, which completes the process. The machine is ingeniously contrived. 3. For the substitution of quartz rock for glass. By taking quartz rock, and grinding and bolting it in any convenient manner, without first calcining it, and using the same as a substitute for pulverized glass, or natural sand, in the manufacture of paper; a better article is said to be thereby produced, from the greater hardness of the material, and the consequent durability of the angles. 4. For sizing the paper after it has received the glass or sand. A wooden roller, covered with felt, is to revolve over a pan containing heated size; its lower side wadding therein; the superfluous quantity which it thus receives is pressed out by a metallic roller, as the felt rises from it. The paper, placed upon a sizing board, is then passed between another metallic, and the felted roller, the grained side of the paper being placed in contact with the felt.

Improvement in the Power Loom. *James C. Kempton, Philadelphia.*—In the weaving of stripes in the ordinary power loom, the width of each stripe is governed by the number of the throws of the shuttle, and in case of the breaking or running out of the weft, the shuttle still goes on, and is replaced by another when it has counted its number, rendering the stripe, in such case, narrower than it ought to be. The object of the present invention is to remedy this defect, by causing the change of shuttle to be independent of the number of throws, and governing it by the actual width of the stripe. On the end of the cloth beam there is what is called a pattern wheel, which revolves with the beam, and has on it cams, which are made to act upon the levers which raise the shuttles; and as these cams operate only by the turning of the pattern wheel, the shuttles cannot be changed until a certain width of cloth is wound thereon; the same shuttle, therefore, may be thrown any number of times, if empty, as the beam will not move

SAFETY STEAM-ENGINE, *Louis Marchand, Baltimore.*—The name of "safety-engine" is given to this inventor, because it is not liable to explode; and provided the confidence of more than one man is necessary to the explosion of a project, we may unhesitatingly aver that it will not explode even in the metaphorical acceptation of the term. A boat is to be propelled, or certain machinery moved, by the power of "one or more men, according to the size of the handle of the *swipe*," which *swipe* is a piece added to the end of a lever, and said lever is to be worked up and down like a pump handle—the *swipe*, or addendum, in some way, which does not, and never will, appear, most marvellously enabling the power applied to produce an effect at least a hundred-fold.

POWER WEAVING, *Aden Holbrook and Ben. French, New Hampshire.*—The improvements made are three in number; the first "is a stop motion, by means of which the loom is stopped of itself, whenever the filling, from any cause, is not thrown into the warp." "Whenever the threads of the warp adhere closely together back of the lese rods, the rods are drawn out of their place towards the harness, by which means defects are produced in the cloth, called draws. In order to give notice to the weaver before any injury arises from this cause, another stop motion has been invented by us; which is the second improvement upon the said loom claimed by us as our invention." "A let-off motion, whereby equal quantities of warp, whenever cloth is made, are unrolled from the yarn beam in equal periods of time, is the third improvement upon the said loom which is claimed by us as our invention. By means of it, cloth of an uniform thickness can be made; it is described as follows," &c.

IMPROVED WATER WHEEL, *H. Averill, New York.*—This is an undershot wheel, to be used in streams where there is but little head and fall. Particular admeasurements are given in the specification, but these we need not notice. The buckets, or floats, are hinged upon the arms, or rims, of the wheel, the hinge being at the lower edge of the bucket as it enters the water; the buckets, therefore, stand in the usual position, bearing against the radiating arms whilst they are entering, and are subjected to the force of the water; but as they begin to rise from it, their hinges admit of their taking a direction which will enable them to leave without lifting it, hanging off from the arms until carried up to the top of the wheel, when, by their own gravity, they fall against them, and are so sustained until they again leave the water. The patentee avers that, after the experience of a year in the use of such a wheel, he is convinced that much power is gained, which, in the ordinary construction, is wasted by the lifting of the bucket, particularly where there is back water. There is no claim made, but the particular object of the invention is sufficiently distinct, and it differs essentially from the hinged buckets which have been so frequently essayed in running streams; we think also that it offers some advantage from the cause stated by the patentee, whilst there is little, or no objection to the hinges on the score of complexity.

MODE OF INCREASING THE ADHESION OF THE DRIVING WHEELS OF THE LOCOMOTIVE STEAM-ENGINE, *Ezra L. Miller, Charleston.*—The mode here patented consists in "using the tender, or car, next the engine, for the purpose of adding weight to the driving wheels of the engine, at such times only as a greater adhesion is required than the weight would give, which it would be practicable to carry as a fixed weight on those wheels, without injury to the road." "At the points of starting," says the patentee, "and on the ascents where increased adhesion is required, I attach part of the weight of the car, or tender, which is next the engine, to the end of the frame of the engine next the driving wheels, which may be done by means of a lever, screw, wedge, or pulley, and detach it again, when the increased adhesion is no longer necessary. The mode which I have used, and found to answer perfectly in practice, is simply to connect the car, or tender, next the engine, to the engine, by a strong iron bar, or lever, one end of which is bolted to the under side of a cross timber in the frame of the car, or tender, a little back of the centre, and which lever extends under the frame of the tender, to the end of the frame of the engine, and into the iron which, together with the drawing bolt, secures it to the engine. Transversely to this lever, I attach to the end of the tender next the engine, two levers, so that their fulcra shall be six or eight inches on each side of the main lever, or drawing bar. These levers have a jaw, or pivot, five or six inches in length, directly over the main lever, and should be about $4\frac{1}{2}$ feet in length. When the increased adhesion is wanted, the engineer has only to place his foot upon the ends of these levers, and press them into a hook, or groove, for that purpose, on the corner post of the tender; and a portion of the weight of the car, or tender, next the engine, is thus thrown upon the driving wheels of the tender; and when the increased adhesion is no longer wanted, this weight is detached by simply loosening the ends of the levers."

MANUFACTURE OF VINEGAR, *Edward Clark, New York.*—The patentee arranges in

the usual way, a number of vessels proportioned to the quantity of liquor to be operated upon. "I then," he says, "connect the upper part of these vessels, casks, or cisterns, by means of pipes, to an air-pump, or any kind of blowing apparatus, in such manner as that, when the air-pump is put in operation, it shall draw a current of air through the vessels aforesaid, and deliver it through a refrigeratory apparatus for the purpose of condensing such portion of the liquor as the air may hold in solution, and thus preventing its loss. Instead of this arrangement, I sometimes force a current of atmospheric air into these vessels, casks, or cisterns, near their bottoms, by means of an air-pump, or other blowing apparatus, from whence it passes to their top, in apparent contact with the liquor, and is from thence led off, by means of pipes, through a refrigeratory apparatus, in the same manner, and for the same purpose, as above set forth and described."

STEAM BUG DESTROYER, *Jonathan Howlet, North Carolina.*—Woe to the bed bugs! should these steam bug destroying machines become as numerous in the United States, as washing, thrashing, and churning machines, of which there seems to be some danger; but what is somewhat curious, they are all alike, and are also all of them similar to such as had been previously described in English journals. As the bugs are doomed to destruction, it might be some consolation to them in their dying agonies, to know that their enemies will not be able to sustain the right which they claim to their "infernal machines" under the patent laws, the great seal to the contrary, notwithstanding.

PUMP GAUGE, *J. D. Woodside, Washington.*—An opening is to be made in the side of a ship's pump, just below the upper band, to receive a small brass box, which may be two inches high, and one and a half wide, and which is to be furnished with a door, to close the opening when the gauge is not in use. A small roller crosses the upper end of the box, and over this passes a tape, graduated into inches and half inches. One end of this tape descends through a casing, nearly to the bottom of the hold, and has a float suspended to it, which will be buoyed up by the water. To the other end of this tape, a counter weight is attached, to take up the slack, by drawing the tape over the roller as the float rises in the water. The patentee says, "What I claim as my improvement, is the vast difference between ascertaining the depth of water in the hold of a vessel by the ordinary sounding rod, and this instrument;—that the depth is more accurately ascertained, as the vibration occasioned by the rise and fall of the water, owing to the motion of the vessel, is at all times perceptible by the graduated tape; therefore, the mean is, the correct depth of water in the vessel."

This claim is very awkwardly expressed, as it is not made for the improved instrument as described, but for the vast difference between the result obtained by it, and by the ordinary means used for the same purpose; and this is claiming the effect of a machine, instead of the machine itself.

PLATFORM BALANCE FOR WEIGHING, *S. L. Hay, Boston.*—The platform balance which is the subject of this patent, is suspended, so far as we know, in a manner different from all those which have preceded it. In this machine there are four levers, which are constructed, and operate, like steelyards, two on each side of the platform, attached to it, and to the frame within which it stands. The fulcrum of each lever is fastened to the frame, one end thereof to the platform, and the other to the transfer rod, by which the motion is to be communicated to the graduated steelyard. The four levers which are attached to the platform, have their fulcra at different distances from their ends; the two on one side differing from the two on the other. In the drawing, the distances, or lengths of the arms in one pair, are as one to ten, whilst in the other they are equal, like a scale beam. This is to cause the platform to descend horizontally, whilst these levers operate upon the transfer beam.

CAST IRON SINK, *Zenos Tarbon and Levi Tarbon, New York.*—The description of this affair is so very brief, that it would seem impossible to say any thing about it in fewer words than those used by the patentees, which are:—"The sink is thirty inches in length, and twenty inches in width, with a soap dish in one corner, and a hole through the bottom to let off the water; all of which is made of pot metal, and cast whole." We do not admire long-winded specifications, but, still, having some portion of curiosity, and some sense of justice, we should like to know how to mete to each of these joint inventors—how much to Zenos and how much to Levi—his due portion of the mental labour expended in inventing the discovery by them set forth. The form of this said sink has nothing new, and is not, therefore, the invention of either; nor is cast-iron, or "pot metal," a new *composition of matter.*

IMPROVED FIRE-ENGINE, *Thomas A. Chandler, New York State.*—If what the patentee states of his engine were true,—namely, that "it will receive and discharge twice the quantity of water, in the same length of time, with half the manual labour of the common fire-engine," it would be well

entitled to the epithet "improved;" but this is most certainly a very great mistake. We really believe, that it would be much nearer the truth to say that, with double the manual labour, it would throw half the quantity of water of the common fire-engine; we are ready to confess, however, that this, though true, would be a libel, as it would be calculated to make an unfair impression; but, most certainly, the friction in this engine will be, at least, twice as great as that of ordinary engines discharging the same quantity of water. There are to be four cylinders, their centres forming a rectangle, and their pistons having rods formed into racks, which take into segment wheels, upon the shaft of the levers that work the pistons. The water, from the four barrels, is to be forced into a common receptacle, furnished with an air vessel, and with two discharge pipes, in order, if necessary, to play two streams at once. It requires no great portion of mechanical knowledge to enable any one to decide, that the rubbing surface of four pistons is much greater than that of two of equal capacity, and of the same length of stroke; that a rack and segment wheel is by no means the best arrangement for working a piston rod; and that the increased number of valves and water-ways must be attended by a considerably increased resistance.

Percussion Cannon Lock, *Enoch Hidden, New York.*—The greatest difficulty which has been encountered in the construction of percussion cannon locks, has been the powerful reaction from the vent, by which the hammer has frequently been blown off, and other injurious effects produced. Springs have been devised to throw the hammer out of the way so instantaneously, that the reaction should not effect it, but the success in this point has been but partial. The main object of the present patent is the same, as will be seen by the following claim:—"What I claim as my invention, and for which I ask a patent, is the manner in which I employ the reacting spring, as described under the various modifications thereof, as herein shown, by which the hammer is instantaneously thrown up, after striking the percussion cap directly upon the vent of the cannon."

Percussion Powder, *Samuel Guthrie, Sackets Harbour.*—"I prepare the percussion powder from any of the materials employed for that purpose, using fulminating mercury, detonating silver, and oxide of tin, or regulus of antimony; chlorate of potash with charcoal, sulphur, sulphuret of antimony, or any mixture of substances capable of inflaming gunpowder, by percussion, forming the same into a paste, and granulating by processes which are well known; sometimes making the grains of a small size, like those of ordinary gunpowder; at other times, I make them of such size that a single grain suffices for a priming, and is substituted for the copper caps used in fowling-pieces, muskets, &c.; or still larger, so that they may be used for the discharge of ordnance of all descriptions. These grains are so compounded, that they are hard enough to be packed up, and carried about, without being liable to be crushed by their abrasion against each other, or by any force to which they are ordinarily subjected. These grains are rendered water-proof, by coating them with shellac, dissolved in alcohol, or any other resinous varnish. Such powder I have, for some time, been in the habit of manufacturing and vending; but I have recently made an improvement therein, which is as follows. Before the varnish with which the grains are coated is perfectly dry, I cover, or coat, them with some metallic substance; and this I do by taking leaf metal, or any of the metallic powders known under the name of bronze, or bi-sulphuret of tin, or any other metal, or metalline compound; and in these I roll the grains whilst yet tackey with the varnish. The powder thus prepared is not only improved in appearance, but has greater smoothness and durability than before. After thus coating the grains, I sometimes apply another covering of copal, or other water-proof varnish, being governed in this particular by the nature of the powder, and the purpose to which it is to be applied."

Shoemakers' Bench, *Samuel Haynes, Massachusetts.*—A long bench is to be made, which may be about three feet high; and from a platform on the floor, a row of standards, or uprights, are to extend up, through this bench, projecting above it to a sufficient height to receive the last in a notch, made for that purpose, on its upper end. These standards are to be about a foot apart, and for one workman there may be ten, or more, of them. Straps are to extend from the lasts, through holes in the bench, their lower ends being attached to treadles near the floor; then, by placing the foot upon a treadle, the strap is strained so as to hold the last firmly down, and by slipping the treadle under a cleat, it becomes fixed. Shoes or boots which are to be wrought upon, are placed on the lasts, and all of them confined in the same position, each in its own standard; this is to enable the workman to pass from one to the other, alternately performing the same operation upon each, and thus avoiding the necessity of a frequent change of tools and position. The patentee says, that, "in this mode, the operator will be able, in a given time, to manufacture and

finish, in a complete, thorough, and workmanlike manner, more than double the number of shoes that he could in the usual mode of manufacturing."

Although there certainly is no great portion of invention in this contrivance, we think that there is sufficient novelty in it to sustain a patent, which will be very valuable, if its utility is equal to, or approaches in amount, that stated by the patentee.

A STEAM-BAKER, *Charles F. Wilcox.*—A steam boiler is to be made by taking two cylinders of iron, one smaller than the other, placing them concentrically, and uniting them by a rim at top and bottom. The space between these cylinders is to contain the water, and the interior cylinder forms a part of the body of the furnace. "The space between the two cylinders, for the generating of steam, must be adapted to the size of the apparatus. In one eleven inches in diameter, and seven inches deep, the space may be one inch wide." In an aperture near the top, a tube is inserted to supply water. The boiler is to be placed on a stand, forming an ash pit, with grate bars to support the fuel. On the top of the boiler there is to be a cast-iron dish, or skillet-like vessel, and this is to be furnished with a tin cover, forming, with the dish, an oven, or cooking chamber. On one side of the boiler, at its upper edge, a brass cock is to be inserted, and a tin tube, with suitable joints and elbows, is to conduct the steam from this cock into the oven, or cooking chamber, an opening being left in the tin cover for that purpose.

"The improvement consists in the mode of conveying the steam, and in connecting the steam with the heat from the furnace, in one operation."

This may really be an improvement in the mode of cooking, but we confess that there appears to us to be more of contrivance than of utility about it; we are much mistaken, therefore, if it is destined to find favour with the kitchen comptrollers.

CENTRIPETAL POWER PRESS, *Eliphalet S. Scripture,*—This press is described as being "upon a new principle," but to us it appears like an old acquaintance, very little altered by time or dress. It is, in fact, a compound lever press, in which the lever that is to make the pressure is to be placed horizontally, and to work upon a pin in a vertical standard, on one side of the frame, its other end working up and down between two vertical standards, where it is acted upon by a second lever, connected to it by links, which operate like the toggle joint. The follower, or pressing part, is on the lower side of the first named lever. This press is spoken of as capable, under different modifications, of being applied to a great variety of purposes, among which are mentioned, printing; packing goods, such as cotton, flour, tobacco, hops; extracting oil, and other juices; also, pressing for clothiers, paper-makers, harness-makers, dairymen, &c.; impressing and cutting metals, &c. From the smallness of its range, there are some of these objects to which it could not be advantageously applied; whilst for others to which it is more particularly adapted, it has long since been employed.

WATER WHEELS, TO PROPEL ALL KINDS OF MACHINERY, RAIL-ROAD CARS, VESSELS, &c.—The construction of this machine is the same with that of some rotary steam-engines which we could point out in the books. A circular drum is to be used, the periphery and ends of which are to be perfectly true, and a wheel, with valves, or buckets, is to be made to revolve in this drum; this wheel, and its valves, must fit perfectly tight, but revolve freely between the heads, and the valves are to slide, air tight, but freely, into openings made in the wheel to receive them. A rod connecting two opposite valves passes through the wheel, so that, as one slides into the space prepared for it, the other is protruded. Two blocks, or stops, on opposite sides of the drum, and about one-third of the circumference of the circle apart, touch in one point the periphery of the revolving wheel, and serve to retract or protrude the valves. Water, under a sufficient head, is to be let in, to act upon the valves, or buckets, and is to be discharged at another opening. In rail-road engines, &c., where there is not a sufficient head of water, it is to be pumped up by hand, steam, or otherwise, into a reservoir, and used over and over again. All who know any thing of mechanics, will now be ready to exclaim, "Stop there, we have heard enough;" and as we think so too, we shall add nothing more.

TIN BAKER, *Josiah St. John, New York State.*—This baker may be made of tin, or other sheet metal, and the form generally given to it is that of an oblong box, with circular ends. In each of these ends, there is a furnace sufficiently large to contain a quart, or more, of charcoal, there being grate bars under the furnaces, made in the usual way. The box between the furnaces constitutes the oven, and boiling is effected in vessels fitted into openings just above each furnace. The dimensions given for an ordinary sized baker, are the following. The body, in which is the oven, two feet in length, by one foot in height and width, with a door on the front side. A circular projection on either end for the furnaces; these projections may be eight inches in length, and nine in height. There is to be a flue from each end, uniting at length in a common pipe. A very good character

is given of this apparatus, by persons who have had it in operation in the city of Washington; it is intended principally for summer use, to which it appears to be admirably well adapted. The quantity of fuel consumed is said to be very small, and, indeed, from the size of the furnaces, this must be the case, much of the effect depending upon the reflecting and non-radiating property of the tin plates.

FORM OF JETS OF WATER EJECTED THROUGH SMALL ORIFICES.

Sir,—I am sorry that Mr. Baddeley did not read my letter, of the 25th of April, with more care; and I am also sorry, that the statements I there made, relative to the contracted vein, are not believed by him. All the argument he has brought (if argument it can be called), to prove that the "*vena contracta*" has no existence, is, that for 15 years he has been in the constant habit of observing jets issuing from various apertures, urged by different forces, but never met with any one instance of perceptible contraction, till the experiment with the flat-topped cylindrical branch pipe. Whether this amounts to any thing like "proof with a demonstration," I leave your readers to judge.

But though Mr. B. may have for a long a time observed the issuing of jets from different apertures, is it not possible that he may have overlooked the contraction, if any there were, when apparatus of a similar kind to that described at page 6, had been tried before, and the "singular phenomenon" he there describes had escaped observation? And when Mr. Baddeley himself, did not perceive the "contraction" till the men got into *full work?*

Be that as it may, I can tell him that the "hypothesis" I stated at page 92 is not my own; and if he prefer his own opinion, when it stands opposed to the result of experiments made by the various learned men who have investigated this subject, it certainly would be very useless in me to attempt to change that opinion. When I stated that "the jet of water issuing through simple orifices is *contracted* in a certain degree in proportion to the extent of that orifice," I had full and undeniable authority for so doing; though, in fact, I expected it was a circumstance with which almost every one was conversant.

Mr. Baddeley appears partly to have misunderstood me, when I said that "the jet issuing through simple orifices is *contracted.*" By a *simple orifice*, I meant an orifice not at all connected with a pipe; or an opening, for instance, in the bottom, or sides of the containing vessel, through which the fluid might pass without having a pipe to aid it in its egress; and I repeat again, that "the jet is *contracted* in a certain degree," which has been proved by Newton, Bossut, and by many others.

The following quotation is from "Gravesande's Natural Philosophy:"—"The chief cause of this difference is the irregularity of the motion spoken of above, (*i. e.* the oblique motion of the water in its approach to the hole,) and which, though it be chiefly observed in great holes, yet takes place in all. By this irregularity, the flowing out of the water is hindered *more than the velocity is diminished. The base of the column of water is less than the surface of the hole.*" What, again, can be the meaning of the extract which follows from another excellent work? "The difference between theory and practice is attributable to the *contraction of the vein of the fluid in passing through the orifice*, in consequence of the different directions which the particles of the fluid take in their approach to it;" and not exclusively to the "varied velocities of the fluid," which seems to be a "gratuitous interpretation" of Mr. Baddeley's.

But the contracted vein is almost annihilated in passing through a tube; it is only through simple orifices that it takes place; and, as was before stated, "the opening in the brass cap may be considered as an orifice not having any connexion with a pipe," or the cylindrical pipe may be considered as the containing vessel, and the $\frac{7}{8}$ opening the simple orifice. It was known even in the time of the Romans, that the contraction of the vein depended upon the apertures being formed in thin plates, and if, instead of such orifices, tubes of a certain length were used, the contraction might be avoided.

What appeared to me, on reading Mr. Baddeley's letter, as the most "extraordinary" thing, was, that the jet of water did not diminish in size,

till the men got into *full work*. Since I wrote my former letter, I have procured a fire-engine, and tried the expe-ment myself; and what appears more "singular" than the "phenomenon" is, that the *contraction obtained the very instant the men began work!* quite contrary to Mr. B.'s statement: and when, by working the engine as slowly as possible, a jet of not more than 4 feet was observed, the contraction was as visible as when one of 30 feet was produced! I have no doubt the pressure of a column of water 15 feet high, such as was made use of by M. Bossut, would be quite sufficient to produce a jet of more than 4 feet. What, moreover, was the cause of the different sounds produced, when particles of air escaped with the water? In the cylindrical capped pipe, the particles of air were driven with great violence against the under side of the cap, and by that means became separated or broken, and so escaped in separate smaller quantities; whereas, in the taper pipe, they are carried through without obstruction.

Mr. Baddeley is mistaken in supposing I have been led astray by Bossut's table, inserted in the "Engineer's Pocket Book:" that I have not seen, and if it contains the "tables" from which Mr. Baddeley has drawn his numbers, it is of no consequence who sees it. The theoretical to the real discharge from circular *tubes*, 1 inch in diameter, under a 1 foot column, is as 1 to .817, and not as 1 to .62133; the ratio of 1 to .62133, obtains in passing through thin plates (similar to the "brass cap"), and not in passing through *tubes*.

I think Mr. B. may now see that what I stated at page 92 is not an "hypothesis;" and he may also perceive, that by expunging that part of his letter at page 6, which states that the jet of water did not diminish in size till the men got into *full work*, the "phenomenon" will be divested at once of that "singular" and "extraordinary" character which he has ascribed to it.

I am, dear Sir,

Very truly yours,

J. L.

Bulbourne, June 23, 1835.

BRICK-MAKING MACHINES.

Sir,—I beg to inform your inquiring correspondent, the brick-maker at Shrewsbury, that when I was at Birmingham this time two years, Mr. John Heaton took me to see some brick-works, which he had established in the neighbourhood of that town.

The marks of his mechanical genius were abundantly evident throughout the works, but I was particularly struck with the plan adopted for tempering the clay. Instead of the customary pug-mill, Mr. Heaton had put up a pair of large rollers, which had formerly done duty in his flatting mill; these were driven by a steam-engine, which, besides turning the rollers, raised the clay from the pit whence it was taken, by means of a waggon running upon an inclined plane.

A waggon load of clay being brought to the foot of the incline, it was attached to the chain, and connected with the steam-engine by hand gearing; the waggon having been drawn to the top of the plane, it discharged its contents over the rollers, and was then returned empty, to be exchanged for a loaded one, and so on continually.

The tempering of the clay, by this means, was much more perfect than in the best constructed pug-mills, and the crushing of the stones continually kept up an incessant deafening noise. The bricks made of the clay thus prepared, were of a very superior kind, and I think this information cannot be too generally diffused.

I observe that Messrs Ride, Coleman, and Co., Leicester, have, in your last number, supplied the precise information required by your Shrewsbury correspondent, and I doubt not he will find their announcement advantageous to him.

I fully agree with these gentlemen, that where limestones abound, tempering the clay *by rolling*, is really the best plan that can be adopted; and that even where limestones are not present in such quantities as to render this method absolutely necessary, still, under all circumstances, it is the very best mode of tempering brick-earth hitherto practised.

Yours, &c., WM. BADDELEY.

June 24, 1835.

MARINE STEAM-ENGINES.

(Extracts from the Evidence given by Joshua Field, Esq., of the house of Messrs. Maudslays and Field, before the Select Committee on Steam Navigation to India.)

693. You have had much experience in the manufacture of engines for steam-vessels, have you not?—Yes, I have.

694. What do you consider the proper measurement and power of a steamer for a long sea-voyage?—The relative proportion of power and tonnage fluctuates between two tons per horse-power and four tons per horse-power, depending upon the purposes for which the vessel is intended, as well as the length of the voyage.

695. What do you say as to the measurement?—By measurement, I understand tonnage. I have prepared a table which shows at one view the probable speed to be obtained by the application of engines of four different powers in vessels of the same tonnage, also the length of time for which they would be able to carry coal with each power on board. This table, if the Committee desire it, I will put in.

AN APPROXIMATE TABLE,

Showing, at one view, the Tonnage of Steam Vessels with the Power usually applied to such Vessels; the Number of Days of Twenty-four Hours' Coals they will carry, and the probable Speed they will go with smaller Powers and greater Quantity of Coal.

Tonnage of Vessel.	Power of Engines.	Days Coal.	Power of Engines.	Days Coal.	Power of Engines.	Days Coal.	Power of Engines.	Days Coal.
252	100	5	80	6¼	60	8¼	40	12
290	100	6	80	7½	60	10	40	15
332	120	7	100	8¼	80	10½	60	14
375	120	8	100	9½	80	12	60	16
425	140	9	120	10½	100	12½	80	15¾
480	140	10	120	11½	100	14	80	16½
534	160	11	140	12½	120	14½	100	17½
597	160	12	140	13½	120	16	100	19
665	200	13	160	16	140	18½	120	21½
736	200	14	160	18½	140	20	120	23½
810	220	15	200	16½	160	20½	140	24
892	220	16	200	17½	160	22	140	26
980	240	17	220	18½	200	20½	160	25½
1,073	240	18	220	19½	200	21½	160	27
	10 miles per hour.		9 miles per hour.		8 miles per hour.		7 miles per hour.	

696. Will you explain to the Committee the object of this calculation; is it a comparison of tonnage with the consumption of coals and days, and the rates of going?—It is to show about how many days' fuel steam-vessels will carry with larger and with smaller engines on board, as well as the average speed to be expected from each. Such a table can only be an approximation.

697. Will you first state what you consider the proper measurement and power of a steamer to go a long sea-voyage?—I should recommend a vessel of from 700 to 800 tons, having an engine of 180 or 200 horse-power.

698. How long would such a vessel run, and at what rate would she go?—She would carry coal for 14 or 15 days, and have a speed in still-water of 9 or 10 miles per hour, and would realise in all weathers at sea an average of 8 miles while under weigh.

699. What is the greatest proportion in tonnage and power for a steamer going a long voyage?—The greatest proportion of tonnage for vessels going long voyages may be stated at 4 tons per horse-power. For short sea-voyages 3 tons per horse-power; and for river vessels, as Margate or Gravesend, 2 tons per horse-power.

700. What results does the power give to a vessel of the same tonnage with different powers as to the rate of going?—Great power in small vessels gives great speed, but they carry a small quantity of coal and are soon exhausted, while larger vessels being able to carry a greater quantity of coals, work longer and perform greater distances.

701. Then you draw this inference—the longer the voyage the less the speed?—The smaller the power the greater capacity there

is left for coal, and, therefore, the greater number of days' coal it would carry.

702. And the less speed?—And less speed having less power.

703. And the smaller proportion of power would of course consume less fuel in an equal time?—Exactly so.

704. Would not the greatest proportion of power consume the least fuel in equal distances?—Against winds or tides it is so, but in calms and fair winds it is not.

705. What is the greatest distance you suppose a sea-going steamer to run without changing?—The same steamer should not go more than 2,000 or 3,000 miles without a relay or time to put the machinery in order.

706. Does that also include without taking in coals?—A voyage of 2,000 or 3,000 miles may be performed in one stage, but it would be desirable on every account to divide it and take less coal.

707. What is the greatest distance she would go without coming to a station to take in fresh coals?—The distance is limited only by the quantity of coal she can carry.

708. What is the greatest distance you think a steamer could go without taking in fresh coals?—The greatest distance I have known a steamer to perform was the Enterprize, on her voyage to the Cape, in which she carried 37 days' coal.

709. With continued steaming, do you mean?—Yes; she steamed 34 days, and had three days coal left.

710. Do you mean steaming day and night?—Yes.

711. Besides the coal, is it not necessary to give the engine rest?—It is; and the more frequently they can be stopped to clean and adjust, the better they will perform.

712. Then your observation must be supposed to apply to both?—Yes.

713. What is the comparison, as to the duration between copper and iron boilers?—Copper boilers are found to last about seven years, without such repairs as renders it necessary to take them out of the vessel, whilst iron boilers must be taken in four years.

714. Which would you prefer on the whole?—I should prefer copper for long sea-voyages.

715. Is not the thickness of the metal an advantage in raising steam?—The metal is of the same thickness, whether the boiler be of copper or iron.

716. The salt water does not affect copper so much as it does iron, does it?—No, it does not.

717. What is your opinion of the relative advantage of the common paddle-wheel, with that of any other invention with which you are acquainted?—The common simple paddle-wheel, when the dip does not exceed one-sixth of the diameter, is an excellent propeller, and scarcely admits of improvement; but when vessels are so deeply loaded that the dip exceeds this in any great degree, a wheel with feathering boards will propel faster.

718. You have fitted river-boats with vibrating cylinders, have you not?—Yes.

719. What may be considered to be their principal advantage over the other?—The advantages of vibrating cylinders in river-boats is, that they are more simple in their construction, lighter, and occupy less space.

720. But in point of weight and space, what is the advantage?—Reduction in weight is the most important consideration in river navigation.

721. Is not the power conveyed more immediately to the crank by the oscillating cylinder?—The power is more durable [directly?] communicated from the piston-rod to the crank: the engines are, as it were, suspended to two strong beams, which lie across the gunwale, and project for the support of the wheels, forming an independent frame, in which the strain of the engine is confined, the whole resting on the upright sides, the weight is more equally distributed over the whole vessel; thus partial pressure on the bottom is avoided; this admits of the vessel's being of the lightest possible construction.

722. Is not the disadvantage, that it is very difficult to keep the connecting pipes steam-tight in oscillating cylinders?—As we construct that part, there is not the least difficulty.

723. Has not that been found to be the case?—Speaking of those we have made, no such difficulty exists.

724. Must there not be continual wear on the connecting pipes, from the motion of the oscillating cylinder?—Not if they are properly constructed.

725. What is the largest power upon which you have constructed those cylinders?—Two thirty-fives is the largest we have made upon this construction, and that was for a sea-vessel.

726. Would you think it advisable to make them of a larger power for sea-going steamers?—The principle is exactly the same in this as if on the ordinary construction; and so far as we have tried them, work just as well, and produce the same effect in speed and economy of fuel as our other engines.

727. What is the advantage of weight and space?—A reduction in the weight of the engine leaves greater capacity for cargo and fuel.

728. What is the extent of the improvement of weight and space?—About 10 per cent.

729. One-fifth of the weight and one-fifth of the space do you mean?—No; about one-tenth of these.

730. Is not the pipe in the fixed cylinder, which brings the steam, connected with the

cylinder by means of flanges, which are secured very tight together; and in the oscillating cylinder, must not the cylinder continually move on the end of the pipe, and is the chance of becoming less steam-tight greater in the oscillating cylinder than it is in the fixed cylinder?—No; the union is effected by a stuffing-box packed with hemp, and is kept perfectly tight without the least difficulty.

731. Is it more expensive than the other?—No, they are rather cheaper.

732. Would they not be apt to be deranged in a heavy rolling sea?—We have not found that to be the case: one has been working in a cargo vessel, between Dover and London, during the last winter to the present time.

733. What is the greatest extent of time that you have had oscillating cylinders at work?—About four years and a half, or five years.

734. On the sea?—No, to Richmond.

735. That is a small high-pressure, is it not?—No, it is a low-pressure.

736. Have you had one on the sea for the last three years and a half?—No; only during the last year.

737. Was there not a second steam-boat, with an oscillating cylinder, going to Richmond?—There was one to Hammersmith last summer.

738. How did that succeed?—Very well, I believe.

739. The packet-boat from Dover to Calais makes use of an engine of that kind, does it?—Yes.

740. Is that one of your manufacture?—No.

741. Is not the friction greater in the oscillating cylinder than it is in the fixed one?—No; as the number of bearings and moving parts are reduced, the friction should be reduced also, unless, indeed, it be badly constructed.

751. Have you considered the construction of the American steam-raft?—I have seen a description of it.

752. Do you think highly of it?—It is certainly an ingenious method of obtaining great speed in smooth water, but its applications is limited.

753. What do you think of the practicability of applying it generally?—It would not do at sea, and as it must draw more water than a single vessel, it would not do for shallow rivers.

754. The speed of it is very great, is it not?—It is so stated, and I believe it may be so for the following reasons: the two pointed cylinders, from their form may be made of the lightest material, and need not be made of larger diameter than is sufficient to displace the total weight; their form offers the least resistance, and their relative position gives the required stability.

755. What do you think is the best kind of coal for steam vessels, with respect to power and safety from spontaneous ignition?—Hartley, Elgin, Inverkeithing, Ward's Llanelly, Llangennech, and Lydney, are all esteemed good coals, and are free from the danger of spontaneous ignition.

756. What is that Scotch coal?—The three first named are Scotch coal.

757. How is the Welsh coal, do you consider, upon those points?—The Welsh coal produces very great heat, and is very effective; but the heat being confined to the fireplace more than other coal, it destroys that part of the boiler faster than the Sotch coal. The heat is more intense in the fire-place, and less is carried forward to the flues than by the other coal.

758. What is the comparison of the proportion of the Scotch coal to the English coal in its power?—I think they are much the same. We have made many experiments, and we do not find much difference.

759. The Welsh coal is considerably greater, is it?—I do not think it is. It has the advantage of not smoking.

760. Is not that because every part of the coal is consumed?—Yes.

761. No portion is carried off, must it not therefore be a coal of greater intensity in a given bulk on that account?—I cannot state that it is more powerful or more economical; but the heat is more intense in the fire-places.

762. Must it not therefore be a coal of greater intensity of heat, than if a portion of it were carried off?—It is not so productive in the flues. It does not carry its heat forward, it is more like the fire of a forge.

763. Then, including the expense and power, you would give a decided preference to one species of coal rather than another?—I prefer the Scotch coal.

764. On what account?—I think it injures the boilers less, and leaves less residuum.

765. What species of Welsh coal do you allude to?—Llangennech and Ward's Llanelly are Welsh coal, and are without smoke.

766. Under what circumstances does spontaneous ignition occur?—Coals which contain iron pyrites, and have become damp, are most liable to ignite.

767. What do you think of the Forest of Dean coal?—Some of the Lydney coal which we tried proved very good.

768. Do you ever use the Kilkenny coal?—No.

769. At what should you estimate the expense of such a vessel as you consider best calculated for a long sea-voyage?—A vessel of 800 tons, and 200 horse-power, would cost about 33,000*l.*, fitted out in the best manner, with engine and every equipment.

770. Then such a vessel as you stated at first, is that the one that you prefer?—Yes.

771. What would be the prime cost, and what the annual expense of such a vessel?—The prime cost would be about 33,000*l*.

772. And what the annual expense?—Do you propose to include the repairs with the expenses of working?

773. Working and every thing else, keeping her up and every thing?—How many days do you propose her to work in the year?

774. Every thing that is to keep the vessel going for as many days as she shall continue, to the end?—The annual cost of working such a vessel, including coal for steaming one-third of the time, and all other expenses, would be about 7,000*l*.

775. In computing the entire expense of a steam-vessel, and annual charge, what amount should you say for capital, the sum for insurance, repairs and renewals, calculated to create the perpetuity of the property?—I think that would not be less than 25 per cent. upon the outlay.

791. By which means could you go the greatest distance without being obliged to take in coals; by the working a small power, and at a slow rate, or by working with a great power, at a rapid rate: for instance, an engine of 100 horse-power, working at 10 miles per hour, or an engine of 40 horse-power, working at 7 miles per hour?—In moderate weather, the small power with a great quantity of coal; but against head winds, a great power will go the greatest distance.

792. In the construction of a river steamer do you prefer the flat bottom with the raking bows, and a parabolic curve?—I think for river steamers where the draught of water is not very limited, the form of the vessels adopted on our river to Gravesend or Margate are best for speed, they are sharp, dividing the water sideways; but, perhaps, in a very shallow river the spoon-shaped bow might be best. I do not know any experiment that would directly set that matter at rest; there are different opinions upon it.

793. What construction do you think the best for steering a vessel round a point against a strong current?—I should think the sharp vessel would steer better than the spoon-shaped vessel.

807. Would it be safe and desirable to use a high-pressure engine in a small vessel on a river, in order to lighten her draught?—I am not acquainted with any high-pressure engine that has been quite successful in a boat yet, all the high-pressure engines that I have seen are as heavy as the low-pressure engines, except in some few instances of a particular kind, which are not fit for general navigation.

808. How is it on the score of safety?—The low-pressure engine is of course much safer.

813. What do you consider to be the comparative advantage of steam navigation in seas and rivers, as to its expense and as to its certainty?—I can speak of the certainty better than the expense; the rate is increased more than double, and the time halved. I have also an abstract of sixteen voyages made between Falmouth and Corfu by sailing vessels; the mail-packets before steam-packets were established; it is the same voyage, and the average is 93 days, the steam-packets giving an average of 47, which is half the time.

814. What is your opinion of the comparative advantage of the navigation in rivers and by sea in steamers as to expense and certainty?—River navigation is less expensive, inasmuch as smaller vessels will suffice, and river voyages are performed with more certainty.

815. Suppose it were 1,000 miles by river, and 1,000 miles by sea, on which side is the advantage, both as to expense and certainty, both by steam?—River, certainly.

816. Suppose you have a whole space of 3,000 miles to pass by water, half of which is in one case to be performed by the river, and in the other the whole by sea, which of the two should you think preferable as to expense and certainty; which should you prefer as a permanent navigation?—Two kinds of vessels being necessary in this case, I cannot speak confidently.

817. Which should you prefer as to certainty?—I should think the certainty much the same in both cases.

818. Should you think a sea navigation as certain as a river navigation?—The Mediterranean packets show it to be very certain, for the fluctuation is only a very few days, which is very little for the whole four years.

819. On which side should you think the speed would be in favour, of the sea or the river, supposing there was a current of 3 miles in the river, and that you had 1,000 miles to go against that current, or 1,000 miles to go by sea, by which, by the river or by the sea, on an average, would you pass over in the shortest space of time?—I rather apprehend the sea.

825. You have given your opinion as to the proportionate power of tonnage to sea-going steamers; on what data do you found that opinion?—From having fitted out a great many vessels.

826. Do you mean vessels employed in the service of Government, or do you mean vessels employed for private purposes?—Both.

827. What number of persons, in proportion to the register of tonnage of the steam-vessel, would you allow for short voyages, and what for long?—How many it would be safe or convenient?

30

828. No; how many men would you wish to take to man your vessel, that is, the crew?—I think about one man to every 30 tons, including the stoker.

829. And what would be the proportion of passengers or soldiers, if you were conveying troops?—About one man to a ton, I should think, or more, for a short distance.

830. You have given us the quantity of fuel of every horse power, have you not?—Yes, I have.

831. What quantity of fuel, and what description, do you allow per horse-power per hour?—We allow eight pounds per horse-power per hour.

832. And what is that calculation founded upon; is it founded upon the average of the consumption?—Upon the consumption and upon experiments made at different periods with engines of our manufacture.

833. What sized cylinder, and what length of stroke do you allow for 180 horse-power?—Two cylinders of $51\frac{1}{2}$ inches, and 4 feet 6 stroke.

834. What would you allow for a 200 horse power?—Two cylinders 53 inches diameter, and 5 feet stroke.

835. What would you allow for a 250?—Two cylinders, 59 inches diameter, 5 feet 6 inches stroke.

836. What would you allow for a 300 horse-power?—Two cylinders, 64 inches diameter, 6 feet stroke.

837. What pressure do you use in the boiler?—About four pounds.

838. And what in the cylinder?—As near the same as an open pipe will receive it.

839. And what proportion is the paddle-wheel to be to the length of the stroke?—From four to five times the length of the stroke.

840. What breadth of float would you recommend?—For river navigation, the wider it is the better; for sea navigation, about one-third the diameter of the wheel.

841. What length of time would an engine work without injury?—In one spell do you mean?

842. Yes?—They are frequently worked from Falmouth to Gibraltar, which is 1,100 miles, in one spell.

843. What is the greatest and the shortest length of time they take to do that distance; that is, a spell of 1,000 miles?—Eight is about the shortest, and 12 the longest.

844. How long should an engine last, if well managed, without repairs?—About from four to five years.

845. What parts of the engine and boilers are most liable to accident?—Those parts most exposed, such as the wheels; then the moving parts, cross heads, beams, &c.

846. Can duplicates of those parts be kept on board?—Yes.

847. Does it require any more engineers to manage an engine of 300 horse-power, than it does to manage one of 100 horse-power?—It does, but not in proportion to the increase of power.

848. In proportion to the power, is a large engine more economical than a small one?—Yes, it is, rather.

849. Does it consume less coal in the same proportion?—It consumes less coal in proportion as the power increases.

850. Suppose a vessel to have 300 horse-power in smooth water or a fair wind, could you work it at the same consumption of fuel which a vessel of 200 horse-power would be worked at by throttling the valves, wire-drawing the steam, or any other mode of working the engines?—Yes, you may do so.

877. Have you ever made experiments on the combustion of wood, for the purpose of raising steam?—I have not myself made those experiments, but I am aware that such have been made.

878. Are you sufficiently acquainted with the subject to give an answer, as to the proportion of space alone that a day's consumption of wood would bear to a day's consumption of coal?—I can only state generally that it requires three times the weight of wood to produce the same effect as coal.

885. You were speaking of the comparative advantages of river and sea navigation; would not the boilers last longer by supplying them always with fresh water?—They would, and that would be an advantage in favour of the river.

886. Are you aware of the improvement introduced into some steam-vessels, to condense the steam in the pipes, without admitting the jet of water into the aperture?—I am.

887. If this were adopted and found efficacious, you would not use the salt-water at all, neither for condensing nor for the boilers, would you?—No, I should not.

888. Do you think it likely that this will be brought to perfection?—I do not know; if it succeeds, it will be a very great advantage.

889. Is the salt water more or less injurious to copper or to iron?—It is much less injurious to copper than to iron.

890. Is it, in comparison with fresh water?—Yes.

891. If that plan, which is now trying, be carried into execution, will that diminish the burthen of the engine itself in the vessel?—No, it rather increases it; but it promises to reduce the quantity of coal.

892. That you find to be one of the effects to arise from the improvement, do you?—Yes, I think that would follow.

893. It would get rid of the condenser, would it?—No, it requires a larger condenser.

894. You mentioned that, as applied to

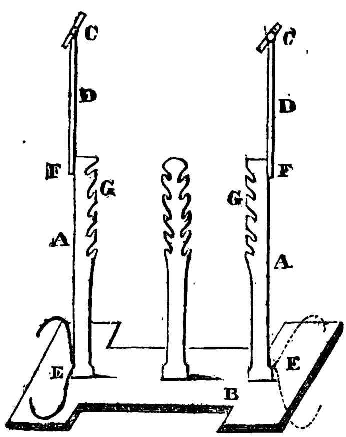
sea voyages, copper would last about seven years, whereas iron would last only about four years; what would be the proportion in fresh water?—In fresh water for steam navigation, the boilers last about seven years.

895. The iron boilers are you speaking of?—Yes; copper boilers are not used in fresh water; there is no inducement to use copper boilers in fresh water, because iron lasts so long.

896. Are copper boilers used in salt water?—Yes.

898. In preferring copper boilers to iron ones for salt water, do you make an allowance for the difference of the tensity in copper, and the different temperature in the boiler; that copper diminishes in tensity as heat is applied, and iron does not?—We find no difference in that respect; the copper and the iron are of the same thickness, and the question turns entirely upon their durability.

JECK'S OCREAN, OR BOOT-WEARERS' ASSISTANT.



The above engraving represents a new patent contrivance, which has recently made its appearance in the shops, and which, though it has much the air of a fashionable conceit, with a most unprepossessing, though legitimately-enough-constructed name, (ocrean from *ocrea*, the Latin for boot), is really a very useful invention. Its object is to facilitate two operations, which, to gentlemen fond of a tight fit, and to all gentlemen of a certain age, are commonly extremely troublesome; namely, pulling on and off their boots.

A A are standards attached to the plate B; C is a handle on the top of the rod D, fastened with the sockets F; E is an instrument attached to the standards A for drawing off boots; G are hooks to receive the boot-straps previous to their being drawn on. The following are the patentee's directions for the two operations of pulling on and off:—

Pulling on.—The boots being fixed in the frame, and the hands resting on the handles, it is necessary to place the toes downwards into the top of the boot, and, by inclining the weight of the body on that leg, the boot is drawn on. Should it be a very tight boot, it is only necessary to draw the handles upwards at the same time, while the other foot is made to rest on the bottom of the frame, to enable any one to perform the operation with surprising ease.—The boots should be hung so as to suit the wearer's height, but in all cases high enough to be clear from the bottom of the frame.

Pulling off.—The hands being placed as before, the instrument attached to each side of the machine is so contrived, that the boot is easily drawn off by raising the leg, without the assistance of any one to bear on the toe.

NOTES AND NOTICES.

Soldier's Cloak.—Captain Dickson, 25th regiment, has invented a cloak weighing but 14 oz., for general use in the army. It is intended to fit on between the soldier's knapsack and mess-tin, and will effectively keep him from wet.—*Hibernian United Service Journal.*

The Poor Working Colliers.—The newspapers announced last week the appointment by the House of Commons (on the motion of Mr. Pease), of a Select Committee to inquire into the causes of the frequent explosions in coal-mines; and this week they furnish one of the most melancholy proofs of the necessity of that inquiry, which has ever yet come under our notice:—On Thursday, the 18th inst., an explosion took place in one of the Wallsend pits, known by the name of the Church Pit, or Russell's Old Wallsend, by which more than a hundred persons, men and boys, are supposed to have been killed. The Davy—"*Safety* Lamp" no longer—was in full use in the pit, which has been the scene of this appalling destruction of human life. We may now surely hope to see the real worth of this much-boasted contrivance placed by the labours of the House of Commons' Committee in its proper light.

Roberts' Safety Lamp.—On Friday evening last, a lecture was given by a Mr. Taylor, at the Eastern Literary and Scientific Institution, the object of which was to show, by actual experiment, that the lamp hitherto used in coal-mines, and invented by Sir H. Davy, is dangerous and insecure, and that a lamp invented by Mr. Roberts is perfectly safe and free from the defects which render the lamp of Sir H. Davy not to be depended upon by the

miners. Mr. Roberts, who has already received several medals from the Society for the Encouragement of Arts, Manufactures, and Commerce, was in attendance, and produced the lamp invented by Sir H. Davy and his own lamp, and assisted Mr. Taylor in the lecture and in the experiments. Mr. Taylor commenced his lecture by explaining the nature of combustion. He described carburetted hydrogen, or fire-damp. He then detailed the doctrine of flame and the progress of combustion. He pointed out by experiments the properties of nitrogen, carbonic acid, and oxygen, and showed the manner in which the safety of the invention of Mr. Roberts is connected with them. Mr. Roberts then displayed his lamp, and described the manner in which it differs from that of Sir H. Davy. He showed the defects of the lamp of Sir H. Davy, the insecurity it affords to the currents of carburetted hydrogen or fire-damp, the dangers arising from the ignition of the small particles of coal adhering to the wire gauze by which it is surrounded, from the oil clinging to the sides of the gauze when the lamp is upset or held in a horizontal position. His own lamp he showed to be free from the two last-mentioned defects. It is surrounded by a double tube of wire gauze, and also by a glass chimney, and is so contrived that a current of carbonic acid air or nitrogen passes continually between the external atmosphere and the flame of the lamp; the flame alone can burn, and any ignition from external explosive current of fire-damp is repelled by the carbonic acid or nitrogen, by which combustion is immediately destroyed.—*Times.*

Sir John Soane and the Institute of British Architects.—" In your notice (p. 224) of the opening meeting of this Institution, you omit to mention a very auspicious incident which marked the close of the proceedings. The President, Earl de Grey, stated that he had a most gratifying letter to read from Sir John Soane, who had not only distinguished himself as an eminent architect, but as a munificent patron of the art to the cultivation of which his life had been devoted. It was a letter, announcing a donation of 750*l.*, in his own name and that of his grandson, John Soane, Esq., for the general purposes of the Institution. The noble President himself proposed a motion for a vote of grateful acknowledgment to Sir John Soane, which was carried by acclamation; and a special meeting was ordered to be convened for an early day to take into consideration the mode in which this noble gift shall be appropriated."—We cordially congratulate the Institution on this most liberal and well-timed donation. The omission of it from our notice arose from the late period of the evening at which it was announced.

London and Birmingham Railway.—" The work through Tring Hill is proceeding very well, and, I may say, *rapidly*. A "*temporary bridge*" has been constructed across the canal at Seabrook, to carry the earth over (the embankments being finished as far as there.) I understand it is not the intention of the Company to put up the permanent bridge till all the earth shall have been carried over. But the foundations for it have been put in some time. The top is to be of iron. Mr. Townsend has lately been laying down a fresh set of rails (*parallel wrought-iron ones,*) in lieu of the common cast-iron, and a new set of waggons have been put on the work. The temporary bridge over the canal is something like a bridge when compared to that which was put over the canal at Wolverton, and pulled down by the Canal Company. (By-the-bye, I think a vote of thanks ought to have been passed by the Railroad Company, and forwarded to the Canal Company, thanking them for their unbounded kindness in destroying a bridge which must have broken by its own weight, and occasioned, probably, a great loss of life.) By what I can learn, they get on very badly in that quarter. Mr. Towns and will complete his part, before the others are well begun. He keeps his men very steadily at work."—K. *Tring, 20th June,* 1835.

Mr. Collier's Boiler.—We regret to find that we made a mistake in our last Number with respect to the transaction between the Lords of the Admiralty and Mr. Collier (through a misreading of the manuscript of our informant), which is calculated to place Mr. C. in a worse light before the public than he deserves. We now take the earliest opportunity of apologizing for, and correcting, it. The real facts of the case we understand are these. The Lords of the Admiralty did pay Mr. Collier the full price (2,000*l.*, we believe) for the boiler fitted on board the Meteor; but after its failure and removal from that vessel, Mr. Collier applied to their lordships for leave to repurchase it at the price of old metal, which was granted. The sum for which it was appraised back to him (funnel included) was 150*l.*, being at the rate of 4*l.* 10*s.* per ton.

A New Steam-Carriage, constructed by Mr. Field (of Messrs. Maudslay's and Field) made a trial excursion on Saturday last, carrying Sir H. Hardinge, Sir H. Parnell, and a select party. In the course of its journey, it went up Denmark Hill, and performed its distance 9¾ miles in 44 minutes.—*From a Correspondent.*

Artificial Marble or Stone Coffins.—These coffins are composed of a cement two thirds of an inch in thickness, solid and hard, yet light in its texture, and on the outside polished, and afterwards varnished.—This glazing or varnish may be an imitation of mahogany, maple, rose, or any other elegant wood. The coffins, it is presumed, are to be made with the lids separate. After the body is placed in it, a thickness of cement is to be laid on the edge of the coffin, to connect the lid, leaving a small opening, to be used temporarily until the air is exhausted by a receiver. This opening also being filled in, the whole is perfectly air and water-tight. The interior being deprived of air, decomposition of the body, and the breeding of those germs of insects which are supposed to be inherent in our flesh, cannot, of course, go on, and must be suspended. The invention far excels the complicated process of embalming, and we doubt not it will be entirely substituted for destructible wood, and come into general use, not only for coffins, but for all kinds of vessels and receptacles in which it is desirable to preserve the contents from dampness and the external air—thus, for records, public documents, books transported to great distances over the sea, &c. In these air-tight coffins, Mr. White proposes to insert in the lid, over the face of the corpse, a thick plate of transparent glass, while the cement is soft, and which thus on hardening, becomes a part of the lid.—*New York American.*

Lord Brougham's Patent Law Amendment Bill, has been before a Select Committee of the House of Lords, and referred back to the same Committee for further consideration. We understand that it has met with great opposition from some of the law lords of the House, and is likely to come out of the Committee quite an altered affair. We shall therefore postpone our intended observations upon it, till we see what shape it definitively takes.

Patent Law Amendment Petitions.—Our advice to our friends at Leicester, and to all-intending petitioners, is to wait till a combined effort for a *real* reform of the existing system can be made with a better prospect of success than at this fag-end of the Parliamentary season.

Fulton's Grand Orrery.—We recommend to the attention of such of our readers as are astronomically inclined—the juveniles of the class, in particular—a grand Orrery, which is now exhibiting in Bond-street, by a Mr. Fulton, from Edinburgh. A Committee of the Society of Arts of Scotland, to

whom it was referred for examination, reported of it in the following terms:—"The particular Orrery under review merits attention from the magnitude of the design, and from the accuracy of the performance. So far as mean annual motion is concerned, it approaches as nearly to perfection as is needed in an instrument of the kind. As an instrument for communicating a general idea of the Planetary System to those who have never had their attention directed to Geometry, the Orrery is unrivalled; and on that account it appears to your Committee that its framer merits a high mark of the Society's favour."—The Orrery is not transparent, but opaque, and is exhibited in daylight, having the Sun and all the Planets, with their Moons, represented by so many gilded globes, all of which revolve in their true (relative) periods. It contains upwards of two hundred movements, effected by means of one hundred and seventy-five wheels and pinions, most of which are exposed to view; and differs from all former Orreries, in exhibiting the motions of all the secondary Planets with the same accuracy as those of the primaries. Our esteemed correspondent, Mr. G. Henderson, of Liverpool, whose practical familiarity with machines of this description entitles his opinion to great weight, says of Mr. Fulton's Orrery, in a letter which we some time ago received from him: —"It is one of the most comprehensive of planetary machines which has ever come under my notice; its usefulness in the way of illustrating the motions of the planetary orbs cannot be over estimated; and I will venture to say, that the tyro in astronomical pursuits will receive a more correct idea of the harmony of the Solar system from Mr. Fulton's Machine, in a few minutes, than by studying all the Astronomical treatises that were ever written."

B.'s right to his invention will not be endangered by exhibiting the results of it merely, as long as he can manage to do so without making public the *modus operandi*.

LIST OF NEW PATENTS, GRANTED BETWEEN THE 22D OF MAY, AND 22D OF JUNE, 1835.

Thomas Fleming Bergin, of Fair View Avenue, Dublin, civil engineer, for certain improvements in the method of suspending and adjusting the bodies of railway and all other wheeled carriages. May 27; six months to specify.

John George Bodmer, of Bolton-le-Moors, Lancaster, civil engineer, for certain improvements in machinery for preparing, roving, and spinning cotton and wool. May 27; six months to specify.

John Losh, of 8, Crescent, Carlisle, for an improvement in the surface or pattern roll of the machines used in printing calico and other goods, commonly called a surface-printing machine, and in the mode of working the said rolls. May 30; six months to specify.

Joseph Nye, of St. Andrew's-road, Southwark, for improvements in pumps and instruments or apparatus for conveying fluids into, and withdrawing them from, cavities of human and other animal bodies, part of which improvements are also applicable to other pumps. June 2; six months to specify.

John Malam, of Kingston-upon-Hull, civil engineer, for certain improvements in gas-meters, and in the apparatus for generating gas for illumination. June 2; six months to specify.

William Wilkinson, of Lucas-street, Commercial-road, engineer, for a certain improvement or certain improvements in the mechanism or machinery by which steam-power is applied to give motion to ships or other floating vessels in or through water. June 2; six months to specify.

Richard Phillips, of New Kent-road, Surrey, lecturer on chemistry at St. Thomas's Hospital, for his invention of certain improvements in the process of manufacturing sulphate of soda. June 4; six months to specify.

James Leman, of Lincoln's-inn-fields, gentleman, for the making, mixing, compounding, improving, or altering of soap, being a communication from a foreigner residing abroad. June 4; six months to specify.

Bennet Woodcroft, of Ardwick, Lancaster, gentleman, for improvements in printing calicos and other fabrics, whether manufactured of cotton, silk, wool, or linen, or of all, or any two or three of those materials. June 4; six months to specify.

Thomas Hancock, of Goswell-street-road, waterproof-cloth manufacturer, for an improvement or improvements in air beds, cushions, and other articles manufactured from caoutchouc or Indian-rubber, or of cloth or other flexible materials, coated or lined with caoutchouc or Indian-rubber. June 4; six months to specify.

Joseph Whitworth, of Manchester, machinist, for certain improvements in machinery, tools or apparatus, for turning, boring, planing, and cutting metals, and other materials. June 11; six months to specify.

Elias Carter, of Exeter, for an improved apparatus for regulating the supply of gas to the burners, and for the stopping off the same, applicable also as a cock in drawing off or regulating the flow of other fluids. June 22; six months to specify.

John William Fraser, of Ludgate-hill, for improvements in apparatus for descending under water. June 22; six months to specify.

James Mitchell, of Truro, Cornwall, for an improved process in smelting argentiferous ores. June 22; six months to specify.

Mr. Needham may obtain the Number he wants through his bookseller.

Communications received from Mr. Haddrick—Iver Maciver—Scrutator Mechanicus (2dus)—An Inquirer—J. P. A.

Our Publisher will give One Shilling and Sixpence for copies of the Supplement to Vol. IX.

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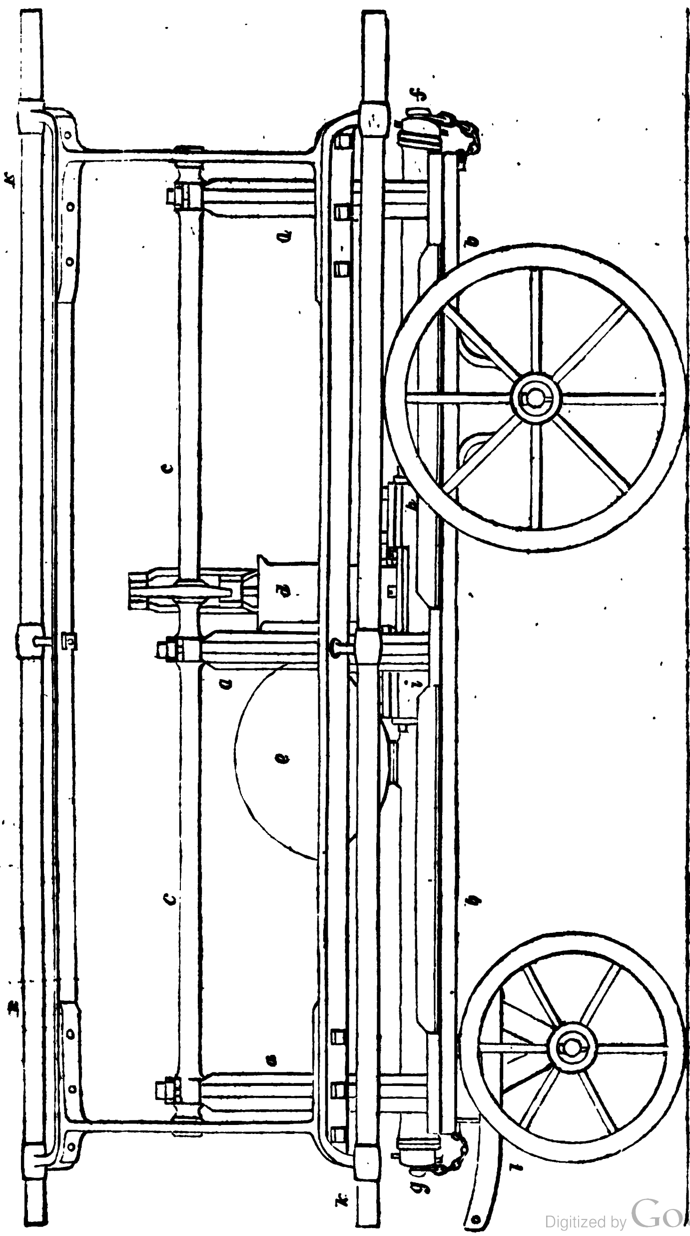
Mechanics' Magazine,
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 621. SATURDAY, JULY 4, 1835. Price 3d.

TILLEY'S NEW METALLIC FIRE-ENGINE.

Fig. 1.



TILLEY'S NEW METALLIC FIRE-ENGINE.

Sir,—After witnessing the introduction of boats, bridges, and churches of cast-iron, with many other extraordinary applications of this highly-useful material, your readers will not be much surprised at the introduction of cast-iron fire-engines, and this material enters pretty largely into the machine I am about to describe.

It is well known that hot climates exercise a most injurious effect upon all things constructed of wood, especially if occasional moisture assists the operation of the heat. Among other machines which manifest the existence of this destructive influence, fire-engines are particularly liable to dilapidation; sometimes saturated with water, and then exposed to parching dryness—laid by unheeded until required for use—no wonder they are so often found unserviceable. To obviate the serious inconvenience arising from this cause, and to render the fire-engine, as far as possible, proof against the effects of climate, Mr. W. J. Tilley, engine-maker, Blackfriars-road, London, has constructed a fire-engine entirely of metal, of which fig. 1 is a side, and fig. 2 an end-view. The same letters of reference apply to both drawings.

aaa are three cast-iron standards, fixed upon a quadrangular floor or frame-work *bb*, of the same material. *cc* is the main axis working in brass bushes on the tops of *aa*. *dd* are the two brass cylinders or pumps. *e* is the air-vessel, of copper; *f* is the suction-pipe; and *g* the delivery-pipe. A chamber *h* contains the suction-valves, the delivery-valves being placed in a similar chamber *i* in front of the cylinders. *kk* are the handles, made of sheet-iron rolled up, which, by means of the cross-levers, impart alternate motions to the pistons.

The pistons are attached by slings to a projecting-arm on the axis *c*, the parallelism of the pistons being preserved by guide-rods in the usual manner. *l* is the fore-carriage.

The whole is mounted on four cast-iron wheels, and has rather a light and elegant appearance.

In the construction of this engine not a particle of wood is employed; the valves, the pistons, and, in fact, every part is of metal.

This engine exhibits, in a very pleasing manner, the situation of all the working parts, which, in fire-engines of the ordinary kind, are enclosed from view; but a most important advantage consists in the facility with which any little derangement in the machine can be seen and remedied. The valves, which are almost the only parts liable to get out of order, can be got at immediately, as it is only necessary to unscrew and remove the cover of the valve-chambers, to examine and repair any obstruction in this part of the machine.

The durability of this description of fire-engine, and its fitness for all foreign stations, especially in hot climates, must be so great, that for such services I have no doubt they will in time supersede all other engines constructed of so perishable and uncertain a material as wood.

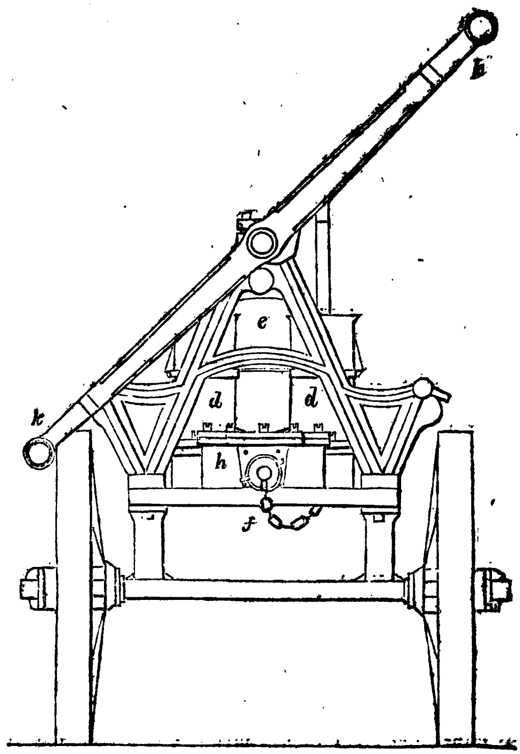
I remain, Sir,

Yours respectfully,

WM. BADDELEY.

London,
June 24, 1833.

Fig. 2.



PORTLAND BREAKWATER.

Sir,—I regret that my official duties have prevented my paying earlier attention to Mr. Lamb's communication, dated 4th March, No. 605; not that I think it a matter of any consequence, as affecting my late father's claim to priority of design for the Portland Breakwater, but lest my silence should be construed as a tacit admission of Mr. Lamb's claims. I take it for granted, that if any communication on a Breakwater for Portland-roads shall appear to have been made by my father previous to June, 1812, (the earliest period to which Mr. Lamb can carry back his suggestion,) then the originality will rest with my father. Now Mr. Ham, with whom I have had no intercourse, directly or indirectly, for more than twenty years, until within the last fortnight, having seen the correspondence in the Mechanics' Magazine, unsolicitedly wrote a letter (published in Mech. Mag. p. 269, vol. xxii.) in which he says, "I can add my testimony, *that in the year* 1800 I frequently heard him (meaning my father) speak of his plan, and give minute details of the same;" and in a subsequent letter which I have received from him, dated 24th May, 1835, he adds—"I can still recollect that he (meaning my father) appeared quite *au fait* in all the details, and delighted to explain them to the nobility and gentry, who so frequently visited his library, when George III. drew such a concourse of them to Weymouth. This allusion, you will perceive, will carry the date of your father's plan even prior to the year 1800. I soon after left Weymouth."

I can mention many other persons who were well acquainted with my father's designs, and to whom he made occasional

written as well as verbal communications, in reference to the subject anterior to 1812. A communication was made to Lord A. Beauclerk, in June, 1810. General Doumourier, an engineer of no common order, had also frequent interviews and conversations with my father on this subject, as being intimately connected with the improvements of our maritime competitors at Cherbourg, then in progress; from him my father received many important hints in futherance of his own ideas. A communication was made to Lord Sidmouth in September, 1810, on the same subject. I have numerous letters to my father from gentlemen who were in the habit of frequenting Weymouth at the time of the visit of his late Majesty, George III., in which reference is constantly made to him as the person who had first suggested the idea of a Breakwater at Portland. My father communicated his design to Mr. Idle, confidentially, in June, 1812, when that gentleman was a candidate to represent Weymouth. At that period the subject was generally discussed, and no doubt from the publicity given to it, Mr. Lamb's intentions originated, as his professional connexion with Mr. Idle afforded him the opportunity of being well acquainted with every transaction, private as well as public, in which Mr. Idle had any share. The slight intercourse which then took place between my father and Mr. Lamb, was not of such a description as to require or induce him to make a confidential communication. The question of originality was never mooted, because there could be no doubt upon the subject. In all my father's extensive correspondence with men of rank and influence, there is but one opinion expressed, namely, that the design first emanated from him. As to my father's silence, on which Mr. Lamb seems to lay so much stress, that merely shows that he was cautious of committing himself to strangers, and that he had not taken any steps to carry his design into execution, because he did not possess pecuniary means sufficient to justify his embarking in so extensive an enterprise. If Mr. Bracebridge *had not known* that my father had possessed plans and particulars before August, 1813, what could have induced him to apply for them? He says under date, August 13, 1813. "Though dismissed, perhaps, for want of encouragement, from your present intention (pending a more favourable period for such an enterprise), I am confident a mind capable of *forming such a design*, could never willingly abandon it. As I understand you had in your possession, plans, soundings, and various requisite materials for this great work, upon which such has been my reflection and contemplation, and consequent admiration of the plan, that I have ventured to mention it to some confidential, scientific, and, otherwise, able friends." &c. &c. Again—"These, sir, were the feelings which led me to wish it may be in my power to render you any service in this matter, *and induce you to turn your mind again to a plan on which you have already bestowed so much trouble and attention.*" Can this be any thing but conclusive? Is there any symptom of a competitor for the credit of origination? Must it not have been known to Mr. Bracebridge, if Mr. Lamb had hinted any intention of claiming the projection of a Breakwater at Portland, and would Mr. Bracebridge have thus written with such a knowledge? Mr. Lamb does not put forth his claim until the year 1834, when Mr. John Harvey, the original projector of this design, is dead. If Mr. Lamb had any pretence to originality in this matter, how happens it that even Mr. Idle, so late as 1818, wrote a letter to my father on the subject, addressing him as being not merely a principal, but the only projector of the undertaking? Indeed that gentleman, as well as Mr. Bracebridge, always considered my father as the individual with whom the design for a Breakwater at Portland had originated. And so did, I may truly say, the entire population of Weymouth and its neighbourhood, since no farther back than July last, 687 of the principal inhabitants signed a petition to his present Majesty in favour of a Breakwater based on my father's plan, in which he was distinctly recognised as the *father of the projected undertaking.*

I am, Sir,
Your very obedient servant,
JOHN HARVEY.

Weymouth, June 6th, 1834.

THE CHERBOURG BREAKWATER.

[The commanding position in which the breakwater constructing at Cherbourg will place the French in regard to

the navigation of the Channel, is, as our readers are aware, one of the strongest of the many strong reasons for the similar undertaking on the opposite coast of England, Mr. Harvey's claims to the original suggestion of which, form the subject of the preceding letter. From the following notice of the *present state* of that work, which we extract from the *United Service Journal* for this month, it will be seen that if England means to be true to herself, she has no time to lose. We are not among those who imagine that there is much risk of the peace which now happily subsists between the two countries being soon disturbed; but it is because we wish to see that peace long preserved that we would have both countries equally well prepared for war. *Arma pacis fulcra.*—Ed. M. M.]

"The great dam, about twenty minutes' walk below Cherbourg, which, together with Fort Napoleon, were so seriously injured by the storms of February and March, 1807, and again by that of February, 1808, is beginning to wear a substantial appearance; it is carrying out in an easterly direction, and will stretch about 3,200 feet (500 toises), from the fort on Pelée Island;* by this means, and a fort at the extremity of the dam, so powerful a cross-fire will be obtained, that it is improbable any enemy will hereafter venture to attempt forcing a passage. The construction of the dam was commenced about fifty years ago; it has been prosecuted under various interruptions, and will probably be terminated after undergoing a host of modifications in the plan of its construction. Political convulsions sunk it almost into oblivion in the days of the National Convention and the Directory; but the work was resumed by Napoleon's directions, in whose time 28,000*l.* were annually appropriated to it. For eight years subsequently to the restoration of the Bourbons it was again wholly neglected. In 1823, however, a sum of 20,000*l.* was spent upon the centre battery; and in 1827, Hyde de Neuville, the Secretary of the Navy, raised the grant to the sum which Napoleon had set down, and it is intended next year to increase it to 68,000*l.* a year; this grant will enable the Government to make rapid advances in completing the masonry of the dam. Cochin, the engineer, has estimated the quantity of stone already sunk in the bight of Cherbourg at upwards of 3,700,000 cubic metres; and not less than 2,800,000 more will be required before the undertaking is completed. Up to the present day the expenditure upon it amounts to more than 840,000*l.* sterling; and it is calculated that as much more will be necessary before it is terminated. The harbour of Cherbourg possesses no claims whatever in a commercial point of view; but in a military one it is of high importance, for there is no roadstead on the French coast fit to be named on the same day with it, with reference to breadth, depth, and security. It is capable of receiving 50 ships of the line, and has space enough for all of them to manœuvre at their ease, *and run out of it at all seasons of the year.*"

* See the chart, Mech. Mag., vol. xiii. p. 203.

NOTICE OF THE PROGRESS OF THE HOT-AIR SYSTEM OF SMELTING IN GREAT BRITAIN. BY M. DUFRESNOY.

(Abridgment continued from p. 176.)

Employment of Heated Air in Cupolas.—There are now many cupolas in which the combustion is sustained by a current of heated air. The little attention paid in England to the consumption of coal, which is spread so profusely over the whole country, has induced them to trouble themselves but rarely to weigh the quantity used in the cupolas. This circumstance prevents my verifying with certainty the advantages which result from this plan. I think, nevertheless, that it will be useful to show the few documents which I have collected on this subject.

At the Tyne Iron-works, already spoken of, near Newcastle, there are two cupolas worked with heated air. They are supplied by the same apparatus which heats the air for the smelting furnace. These cupolas are circular, five and a half feet high, thirty inches diameter in the clear, constructed with fire brick, encased in cast-iron. They receive the air through two tuyeres, placed one over the other, each two inches and three quarters in diameter. From one of the proprietors, I learn that the consumption of these cupolas is 280 lbs. coke for each ton of iron melted. Casting on an average one ton per hour. These cupolas have been constructed since the introduction of the hot air plan.

At Wednesbury, in the works of Lloyd, Forster, and Co., the cupolas are rectangular; about seven feet high, with a space in the clear of thirty-six by thirty inches. The air is introduced by two tuyeres, three inches in diameter. They cast in these furnaces one ton of metal per hour, each operation lasting twenty minutes, consuming 260 lbs. of coke;—before the adoption of hot air, the ton of iron required 400 lbs. of coke. The greatest influence produced in these furnaces by the hot air, is, the rapid reaction of the charges, the time having been reduced from

forty to twenty minutes for a heat. At Wednesbury, the quintal of iron melted with cold air, twenty pounds consumed of coke: with the hot air, this is reduced to thirteen pounds.

Messrs. Cosle and Perdounet (*Annales des Mines*, II *Série*, vol. vi. p. 85,) indicate that the quantity of fuel consumed in the cupolas of Birmingham, Manchester, and Newcastle, averages twenty-five per cent. of the weight of metal melted. If we compare these proportions with the quantities now given, we see that since the adoption of the hot air plan, a saving has been effected of one-half in fuel, and other expenses in the second melting of the iron.

Employment of Heated Air in Refineries and Smith's Forges.

The use of heated air has been tried in the refining of iron, and in the forges to work it.

I have not had occasion to visit works where trials have been made in blowing the refineries with hot air, but I know that at the Janon forge, near St. Stephen, the results obtained by using this plan have been but slightly favourable to its introduction; the same experience has been had near Birmingham. The want of success of this plan in refineries does not invalidate the evidences of its advantages in the smelting furnace, which has been proved in so many instances.

This difference in the results of the use of heated air in the smelting furnace and the refinery, appears to show that the air operates upon different principles in the refining of metal and fusion of the ore.

I have stated, at the commencement of this Report, that the first trial of heated air was made by Mr. Neilson, on a smith's forge, at the Glasgow Gas-works.

The air is heated by the same fire as the forge, by means of a double cast-iron box, which forms the bottom of the forge fire. Mr. Neilson showed the operation of this apparatus by having several bars of iron, of different sizes, forged in my presence, so that I could judge of the effect produced. Not having seen comparative experiments, it is difficult for me to form a judgment of the advantages derived. I cannot, however, conceive that the feeble temperature which the air could acquire in the apparatus adapted to this forge, could have much influence upon the economy of the operation. I had the fire cleaned out, to see the exterior disposition of the apparatus, and, at the same time, to appreciate the time necessary for welding. The fire was then laid on, and in four minutes after, lighted coal was placed on the forge, a bar of iron, one inch square, was heated to a white heat. In taking it from the fire, this bar shot forth brilliant scintillations, and the little scoria that covered it ran in liquid drops. The bar, plunged in water, was still, after being immersed a minute, a dark red, but hot enough to be hammered. I have not been able to determine the quantity of fuel consumed; it varies according to the size of the bars to be worked. Mr. Neilson assures me that the consumption of fuel in this forge has been reduced one-third since it has been fed by hot air.

It appears that there are many smelting forges in which they have adopted this new plan.

[In a subsequent number we shall give M. Dufresnoy's Report on the results of the trials made upon heated air in France.]

MARTIN'S ARITHMETICAL FRAMES.

The powers of numbers, and their relation to each other, have been in a variety of ways demonstrated; but rarely indeed with any important practical application: we have ingenious theories of the wondrous powers of the number 9, and a variety of arithmetical legerdemain is abroad, which appears to the curious very singular and astonishing. Napier's bones or rods afford some good illustrations of the multiplying powers; but there appears to have been no instance of the successful application of the "occult powers of numbers" till the invention of the "Arithmetical Frames," by Mr. Martin, which are, without question, applied to a use the most important and extensive. But when we come to make an examination of these, we are unable to ascertain, except in one or two cases, the principles upon which they are constructed. In these frames we have what is most extraordinary, a system of arrangement which carries out, *ad infinitum*, practical exhibitions of all the elementary rules, not singly only, but also in every variety of combination which the ten digits will make, affording demonstrable proofs of the correctness or incorrectness of every figure; at the same time that none but the teacher who has been previously informed of the mode of detecting error, can by any possibility be informed of it. A dozen exercises of fifteen or sixteen figures each, may be worked in *one* rule only, or through the whole *four* rules, and be checked by the master at a mere glance, while those exercises may be varied to the extent of many thousands of millions times, and be proved by the same mode and with the same facility. It has often occurred to mathematicians, that a series of num-

bers might by some possibility be arranged, so as to produce uniform and known results in an almost infinite series; but this suspected power of the arrangement of numbers has never been shown, excepting in a few cases of particular numbers; and even these have not been applied to any practical purpose, excepting by Patrick Whytock.* But this arrangement, which is founded on the peculiar properties of certain decimal fractions, is defective, as it only refers to the simple rules, whereas the arithmetical frames or tablets constructed by Mr. Martin, comprise also the *compound rules;* and this appears most extraordinary; for there cannot well be worse decimal relations, supposing they are constructed on this principle, than those of the numbers 4, 12, and 20, which form the integral parts of our common currency; but Mr. Martin has arranged and can apply, if necessary, his principle through all the *weights and measures*, affording an infinite variety of examples, whose solutions bear such a relation to their propositions, that their correctness or incorrectness is immediately discoverable by him who has learnt the mode of discovery; and which may be acquired, by any one conversant with addition and multiplication, in a few minutes. Nor is this all, for the frames are so arranged that the smallest as well as the largest examples may be given; that the working of the examples of one rule gives examples in another, and the working again of these examples in a third, and so on—proving the correctness of each, even to the pupils themselves, and pointing out error; at the same time that the master has a counter check, which he can apply in a moment to a whole morning's set of exercises. Such a plan, where a large number of boys are to be taught, as in National and Lancasterian schools, must be of incalculable advantage; and even in private schools must afford great assistance to teachers, from the variety of examples presented, and the ease with which their answers may be ascertained.

Description of the Frames.

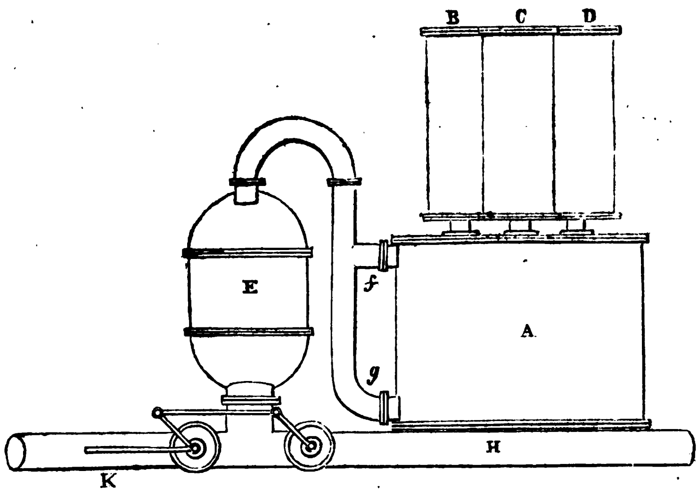
The "Arithmetical Frames" consist of six frames, about 18 inches high and 1 foot broad. The first of which is fitted up with little balls transversely arranged on four brass rods, as the ball frame of the infant schools; but to this, which only forms the top part of the frame, nine cubical rods vertically placed, and revolving on pivots, are attached: on one side of these rods are small pictures about an inch square, of ships, horses, cats, cows, and such like figures differently coloured; their object is, as is also that of the balls, to teach the *infant* to count, and to connect abstract signs with tangible objects. The other three sides of the rollers are filled up with three numeration tables, so ingeniously disposed, that by the turning of the rods, every variety of change of figure may be produced so strikingly, that a few hours are generally sufficient to teach a child the principles of numeration and notation with the rudiments of addition.

The succeeding frames comprise a frame for each of the following rules: the addition frame consists of 12 cubical rods or rollers, *horizontally* placed, and by the simple turning of these, an infinite number of examples may be produced, and their answers discovered in a moment. To the subtraction frames, which are constructed to hold only two rollers at a time, containing the subtractors and the subtrahend, large slates are also attached, on which the remainders are worked, one below the other, forming an example in addition, which is added up. The multiplication and the division frames are made to contain only one roller, the former has a slide upon which the multipliers are printed, which shows one figure at a time through a square hole immediately under the unit of the multiplicand, and the latter has a slide for the divisors moving up and down upon the dividends to change the examples; by which simple contrivance, as many changes may be produced as upon a peal of 12 bells, stated to be several thousands of millions. In these two latter frames there is still a recapitulation of preceding rules, with different examples applied throughout the compound as well as through the simple rules;—the whole forming a system of teaching the theory of arithmetic so complete, as to make improvements extremely difficult, and presenting a combination of figures whose results are, as we have stated, "most extraordinary in

* See Mech. Mag., vol. xviii. p. 43.

the history of the relations of number;" and their effects on the children who are taught by them, as is exemplified at the Borough-Road Central Schools; to use the words of Lord Brougham, in his speech on Education—"present the most extraordinary spectacle of the progress of obtaining information which might be made by children, and which he had never seen or heard of at any place, in any country, or at any time. It was perfectly wonderful how the human faculty could, at so early an age, be cultivated to so marvellous a degree. A dozen or two of the children were asked such questions as the interest of various sums of money for any time, at any rate per cent., and their answers were as correct as they were immediate." His Lordship repeated, that "he had never witnessed a more extraordinary exhibition."—*Educational Magazine.**

PLAN FOR PROPELLING STEAM-VESSELS BY THE RETROACTIVE FORCE OF A COLUMN OF AIR.



Sir,—The above sketch represents a plan for propelling steam-vessels by a powerful current of air ejected from the stern of the vessel. Water has been tried in a variety of ways to effect a similar object, but I am not aware of any trial having been made similar to the plan proposed.

A is the cylinder of the air-pump, with three inverted steam cylinders on the top, marked B C D. The piston rods of the inverted cylinders work the plunger of the air-pump, and are attached to it at equal distances from the centre, and at equal distances from each other. The cylinder of the air-pump being 10 feet diameter, it is presumed that three steam-cylinders so placed would be a better arrangement than with one in the centre, if even equal to the three in capacity.

E, an air-vessel, which the air is forced into at the passages *f g*, alternately, with each stroke of the pump. Those passages have valves to prevent the air returning into the cylinder of the air-pump.

H, a cast-iron pipe running from the

* An excellent journal, which we gladly take this opportunity of recommending to the notice of our readers—to those of them specially who are of the scholastic profession. It is conducted in a most enlightened spirit, and with views of the purest philanthropy. Its object is identical with that of the *Quarterly Journal of Education*, namely, the improvement or *rationalising* of our existing systems of education; but, while not inferior to its predecessor in point of talent, it is advantageously distinguished from it in this, that while the *Quarterly* regards the cultivation of the intellect as almost the sole thing needful, the *Educational* attends equally to the heart and the head, and even looks upon the former as the more precious object of the two.—ED. M. M.

pipe to the stern of the vessel, and open at both ends to the water. There are two cocks or valves to this pipe, one on each side of the air-vessel. When the air is blowing off to propel the vessel forward, the lever K of the hand-gear is in the situation represented in the figure; when the lever is raised a little higher, the air will rush out at both ends of the pipe H, and neutralize the propelling force, and if raised a little more, it will be discharged at the prow of the vessel only. That a power of starting, stopping, and backing the vessel, may be thus gained, is obvious.

If we suppose the air discharged by the pump to be condensed to one-fourth of its original volume, and the cylinder of the air-pump to be 10 feet diameter, with a 6 feet stroke, making 18 strokes per minute, about 4,000 cubical feet of air would be discharged every minute from the stern of the vessel. *Question,*—What would the probable result of such an experiment be, as respects the velocity of the vessel so propelled, to the power expended, when compared with paddle-wheels?

I am, Sir,

Your very obedient servant,

J. W.

April 24th, 1835.

THE SHIP-SINKING SYSTEM.

Sir,—When noticing Mr. Ballingall's ingenious and philanthropic work, entitled "The Mercantile Navy Improved" (see Mech. Mag., No. 506), and animadverting on the obstinate resistance made to every attempt to introduce into the mercantile service those improvements in construction which have given to king's ships such an immense superiority over all others in point of stability, you pertinently ask, "Is it stupidity, economy, villany, or what, that causes the wanton exposure of life and property?" If I might presume to supply an answer to the question, it would be this: "Neither is it stupidity nor economy, nor yet any other motive which it would be decent to avow, that is the cause; but an atrocious spirit of gambling, for filthy lucre sake, which makes no more account of the lives and souls of men, than if they were so many brass counters." Much sinking of ships is indispensable to the driving of a brisk trade in Sea Insurance; and in order that Lloyd's may flourish, thousands of the best and bravest of our countrymen, and millions of property are every year *systematically sacrificed*. We shall never, I am thoroughly convinced, have a safe merchant ship in Great Britain, as long as the worthies of Lloyd's can possibly prevent it. For to use the words of the Edinburgh Petition to the House of Commons, which I am glad to see echoed in another excellent one from South Shields, "Were trading ships only made as safe and durable as ships of war, there would be an end to Sea Insurances, and with them the gains of underwriters. If a ship be wrecked to pieces, the ship-builder has no cause to mourn; another is ordered in its place, as weak and fragile as its predecessor. Nor does the ower suffer, the vessel being generally insured for much above her actual value. The merchant, too, is relieved from all anxiety, his cargo being guaranteed in a similar manner. Thus let the destruction of shipping be what it may, the premiums being always so enormous, the Insurance-brokers in the end constantly derive an advantage; and as the loss of every vessel diminishes the supply of goods in the market, the price of commodities necessarily rises, and the final loss, as usual, falls on the consumers. Hence these great stake-holders, the underwriters, ship-builder, ship-owner, and merchant, not only manifest indifference to shipwrecks, but under pretence of classification of merchant shipping, have apparently taken the most effectual measures to prevent safe vessels being built." The insidious system of "classification," alluded to at the close of this extract, has been recently revised, and what is called a "new system of registration" adopted; but the new system is just as much in the shipwrecking interest as the old. The entire tendency of it is to take away all inducement from the ship-owner to study strength of construction, by classifying ships according to their age without any regard to their strength. After a ship has lasted nine years, it is at once reduced to the second class, no matter what its strength may be; and because thus arbitrarily disrated, the premium for insuring it is increased; no distinction is made between good and bad ships of the same age—the best and the worst fare alike.

"If a vessel has passed the fatal climacteric,

although she should possess the strength of a rock or a castle, it is quite in vain for the owner to allege her strength, safety, and superior equipments. A merchant cares nothing about their things, and has the ready objection—'I can get my goods carried at the same rate of freight, and at a lower premium of insurance, in a first-class vessel;' nor in general does it give the merchant any concern after his insurance is effected, although ship and cargo go to the bottom immediately on leaving port."—*Pernicious Effects of Sea-Insurance, Kirkcaldy*, 1834.

'Tis indeed a most ingeniously devised system of iniquity, but no other than what might be expected from the parties who have had the concocting of it. When the serpent shall wish cunning to the dove, the fox caution to the goose, or the lion strength to the lamb, then may we expect to see underwriters and insurance-brokers devising plans for the prevention of shipwreck—*but not till then.* The only hope for humanity is, that Parliament will take the matter altogether out of their hands; either by abolishing marine insurance entirely, or by making such independent provision for ascertaining the sea-worthiness of merchant vessels, that none shall be allowed to be freighted with the fortunes of a single human being (saving, perhaps, the builders and owners), which has not been constructed with (at least) as much regard to safety as the best of his Majesty's ships.

This brings me, at length, to the main purpose of this letter, which is to request that you would give a place in your widely-circulated and influential pages to the following remarkable instances of what strength of construction has done for King's ships, under circumstances which would infallibly have proved the destruction of ninety-nine in a hundred of our merchant-men. In the King's ships, as most of your readers are probably aware, the hulls consist of a solid mass of wood-work of from 15 to 21 inches thick; while the safety of merchantmen, and of all they contain, is ordinarily dependant on an outer planking of no more than 3 inches.

The first instance is that of his Majesty's steamer Lightning, which, besides being built in the solid manner just mentioned, was provided with Mr. Oliver Lang's safety-keel.* After being made ready for sea, as she was on her way out of the river Thames, she ran on shore a little below Sheerness, on the Spaniard shoal, and fell over on her side, where she lay dry at low-water. She floated again, however, at high-water, and it was found she had sustained no damage whatever. As she was entering Dover harbour, soon after, she ran full speed against the pier, and struck her fore-foot or gripe, knocking it over on one side; but still she made no water, and, when subsequently examined in dock at Portsmouth, she was found to be perfectly tight. Her next mishap happened as she was going into Jersey, when she ran with great violence on shore, and fell over on her side at low-water; the shock produced by her fall was severely felt, particularly in the engine-room, but she sustained no material damage in her fabric, notwithstanding she was left dry, by the water receding from her above 150 feet. At another time, when in the Downs, she was run into by a loaded collier, which struck her just abaft her starboard paddle-box. The consequence was, that her sponcings and sponcing-timbers were broken, but that was all; while the collier was obliged to run on shore to escape sinking, her bows having been completely stove in by the concussion. In the heavy gale of wind in February, 1833, the Lightning was in the Irish channel, on her way to Dublin, at the same time that the Erin steam-vessel foundered in the gale. The Lightning made her voyage in safety, but she had the misfortune to run against some rocks, and carried away the fore-parts of her keel and gripe. However, she made no water after the accident, and continued afloat for the space of two months before she was docked, without any leak whatever being found. In October, 1834, she ran upon the rocks near Helsineur, going, at the time, between eight and nine knots an hour, and remained fixed there for ten hours, dropping and raising head and stern successively. The gripe, part of the fore-piece of the keel, and midship-piece, by which she was hung upon the rocks, were, during this time, carried away, and the whole of her keel, fore and aft, was rubbed off for about three or four inches; yet all this, notwithstanding, she still remained in good sailing, or, rather, steamer-trim. After getting off

* For a description of this, see "Nautical Magazine," vol. i. pp. 361, 520.

in this damaged state, she experienced a heavy gale of wind, which lasted four days, and from which she sought shelter in Heligoland. Here, however, she parted both her cables, and was again driven to sea, *at the same time that the Superb, one of the common-built steamers, was lost.* The Lightning bore all her misfortunes well. It was observed by those on board her at the time, that she did not work or strain in any part; not a door was jammed or altered, nor a seam or butt opened; nor was her pitch even broken in any place; she showed no sign whatever of altering her form, but remained perfectly tight. On repairing afterwards the keel, it was found, in removing the damaged part, that it was quite dry within; no water had penetrated into the hull of the vessel; and the caulking of the seams and wood ends was hard and sound.

The second instance is that of his Majesty's steam-vessel Flamer, constructed in a similar manner to the Lightning; she went on shore on the rocks at Zante, in the Mediterranean, going nine knots, and was carried up two feet higher than her draught of water. She remained on shore twenty-two hours; the fore-piece of the keel and gripe were carried away, the copper was torn off from her bilge, and the plank of her bottom much injured. She was lightened, however, and got off, came to England safely, and when taken into dock at Woolwich about six weeks after, the caulking was found hard and sound, even close to those parts that were carried away, and the ship showed no appearance of straining or having suffered in her fabric by the violence of the concussion.

Can any person, after such instances as these, doubt the vast superiority of the Royal Dock-yard system of building? Or any one (unless of Lloyd's) refuse to join heart and hand in the endeavour to make *all* the wooden walls of old England, whether Royal or Mercantile, equally safe and impregnable?

I have the honour to be, Sir,

Your very obedient servant,

A First of June.

WEAVING WIRE.

Sir,—It is not generally known to what degree of perfection this art is carried. I have lately seen a specimen of wove-wire gauze in which there are not less than 150 holes in the inch long, manufactured by Mr. Corcoran. The idea struck me that this article might be used with advantage in many manufactures where lawn and linen are now used. The degree of fineness in this fabric, which tears like paper, is very great; and the texture and appearance are really beautiful. It has not hitherto been used for any purpose that I can discover; but, with the march of improvement, and the consequent application of new means, I shall not be surprised some day to see our ladies' ribbons composed of extremely fine wire thus woven. But this is going beyond my original intention.

I remain, Sir,

Yours respectfully,

A Subscriber.

Kensington Gore, July 1, 1835.

HONE-STONES AND GRIND-STONES.

We extract from the last Part of the Transactions of the Society of Arts the following valuable descriptive catalogue of a collection of hone-stones and grind-stones, presented to the Society by Richard Knight, Esq., of Foster-lane:—

"1. *Grit or Sandstone.*—Of this variety the celebrated Newcastle grind-stones are formed. It abounds in the coal-districts of Northumberland, Durham, Yorkshire, and Derbyshire; and is selected of different degrees of density and coarseness, best suited to the various manufactures of Sheffield and Birmingham, for grinding and giving a smooth and polished surface to their different wares.

"2. Is a similar description of stone, of great excellence. It is of a lighter colour, much finer, and of a very sharp nature, and at the same time not too hard. It is confined to a very small spot, of limited extent and thickness, in the immediate vicinity of Bilston, in Staffordshire, where it lies above the coal, and is now quarried entirely for the purpose of grind-stones.

3. Is a hard, close variety, known by the name of carpenters' rub-stone; being used as a portable stone for sharpening tools by rubbing them on the flat stone instead of grinding. It is also much employed for the purpose of giving a smooth and uniform surface to copper-plates for the engraver.

"4. Is a much softer variety of sandstone, usually cut into a square form, from 8 to 12 inches long, in which state they are

used dry by shoe-makers, cork-cutters, and others, for giving a sort of coarse edge to their bladed knives, and instruments of a similar description.

" 5. A stone of similar properties, but of a more compact and harder description, and therefore better adapted for sharpening agricultural instruments, and may be used with or without water.

" 6. A porous, fine-grained sand-stone, in considerable repute, from the quarries of Black Down Cliffs, near Collumpton, and well known by the name of Devonshire Batts.

" 7. Is a variety called Yorkshire Grit. It is not at all applied as a whet-stone, but is in considerable use as a polisher of marble, and of copper-plates for engravers.

" 8. Is a very similar stone, of a softer nature, and made use of by the same description of workmen, and is called Congleton Grit.

" *Hone-Slates.*

" 9. Norway rag-stone.—This is the coarsest variety of the hone-slates. It is imported in very considerable quantity from Norway in the form of square prisms, from 9 to 12 inches long, and 1 to 2 inches diameter, gives a finer edge than the sand-stones, and is in very general use.

" 10. Charley Forest-stone is one of the best substitutes for the Turkey oil-stone, and much in request by joiners and others, for giving a fine edge. It has hitherto been found only on Charnwood Forest, near Mount Sorrel, in Leicestershire.

" 11. Ayr-stone, Scotch-stone, or snake-stone, is most in request as a polishing stone for marble and copper-plates; but the harder varieties have of late been employed as whet-stones.

" 12. Idwall, or Welsh oil-stone, is generally harder, but in other respects differs but little as a whet-stone from the Charley Forest; but in consequence of its being more expensive, is in less general use. It is obtained from the vicinity of Llyn Idwall, in the Snowdon district of North Wales.

" 13. Devonshire oil-stone is an excellent variety for sharpening all kind of thin edged broad instruments, as plane-irons, chisels, &c., and deserves to be better known. This stone was first brought into notice by Mr. John Taylor, who met with it in the neighbourhood of Tavistock, and sent a small parcel to London for distribution; but, for want of a constant and regular supply, it is entirely out of use here.

" 14. Cutler's green hone is of so hard and close a nature, that it is only applicable to the purposes of cutlers and instrument-makers, for giving the last edge to the lancet, and other delicate surgical instruments. It has hitherto been only found in the Snowdon mountains of North Wales.

" 15. German razor-hone. This is universally known throughout Europe, and generally esteemed as the best whet-stone for all kinds of the finer description of cutlery. It is obtained from the slate-mountains in the neighbourhood of Ratisbon, where it occurs in the form of a yellow vein running virtually into the blue slate, sometimes not more than an inch in thickness, and varying to 12 and sometimes 18 inches, from whence it is quarried, and then sawed into thin slabs, which are usually cemented into a similar slab of the slate, to serve as a support, and in that state sold for use. That which is obtained from the lowest part of the vein is esteemed the best, and termed old rock.

" 16. The same, with the hone in *natural* contact with the *slate*.

" 17. Is a dark slate of very uniform character; in appearance not at all laminated; is in considerable use among jewellers, clock-makers, and other workers in silver and metal, for polishing off their work, and for whose greater convenience it is cut into lengths of about 6 inches, and from a quarter of an inch to an inch or more wide, and packed up in small bundles of from 6 to 16 in each, and secured by means of withes of osier, and in that state imported for use, and called blue polishing-stones.

" 18. Is a stone of very similar properties, but of a somewhat coarser texture and paler colours, and thence termed grey polishing-stone. Its uses are the same, and they are manufactured near Ratisbon.

" 19. Is a soft variety of hone-slate, the use of which is confined to curriers, and by them employed to give a fine smooth edge to their broad and straight-edged knives for dressing leather. They are always cut of a circular form, and are called Welsh clearing-stone.

" 20. Turkey oil-stone.—This stone can hardly be considered a hone-slate, having nothing of a lamellar or schistose appearance. As a whet-stone, it surpasses every other known substance, and possesses, in an eminent degree, the property of abrading the hardest steel, and is at the same time of so compact and close a nature, as to resist the pressure necessary for sharpening a graver, or other small instruments of that description. Little more is known of its natural history than that it is found in the interior of Asia Minor, and brought down to Smyrna for sale.

" 21. The French Burr mill-stone, so justly esteemed as the best material for forming mill-stones for grinding bread-corn, having the property of separating a larger proportion of flour from the bran than can be effected by stones formed from any other material.

" 22. Conway mill-stone very much re-

sembles the French in appearance. A quarry of this was opened near Conway, about twenty years since, which at first appeared very promising; but it was soon discovered that it was the upper stratum only that possessed the porous property so essential, the lower stratum being found too close and compact to answer the purpose.

"23. Cologne mill-stone.—This substance is an exceedingly tenacious porous lava. Mill-stones are made of this material in great quantity near Cologne, and transported by the Rhine to most parts of Europe. Smaller stones, from 18 inches to 30, are much used for hand-mills in the West Indies for grinding Indian corn, for which purpose they are well adapted.

"24. Emery-stone.—No substance is better known, or has been subservient to the arts for a longer period, than this. The gigantic columns, statues, and obelisks of Egypt owe their carved and polished forms and surfaces to the agency of emery. It is obtained almost entirely from the island of Naxos, where it occurs in considerable abundance in detached irregular masses. It is reduced to the state of powder by means of rolling or stamping-mills, and afterwards by sieves and levigation.

"25. Pumice-stone is a volcanic product, and is obtained principally from the Campo Bianco, one of the Lipari islands, which is entirely composed of this substance. It is extensively employed in various branches of the arts, and particularly in the state of powder, for polishing the various articles of cut-glass; it is also extensively used in dressing leather, and in grinding and polishing the surface of metallic plates, &c.

"26. Rotten-stone is a variety of Tripoli almost peculiar to England, and proves a most valuable material for giving polish and lustre to a great variety of articles, as silver, the metals, glass, and even, in the hands of the lapidary, to the hardest stones. It is found in considerable quantities both in Derbyshire and South Wales.

"27. Yellow Tripoli, or French Tripoli, although of a less soft and smooth nature, is better adapted to particular purposes, as that of polishing the lighter description of hard wood, such as holly, box, &c.

"28. Touch-stone is a compact black basalt or Lydian-stone, of a smooth and uniform nature, and is used principally by goldsmiths and jewellers as a ready means of determining the value of gold and silver by the touch, as it is termed—that is, by first rubbing the article under examination upon the stone, its appearance forms some criterion; and, as a further test, a drop of acid, of known strength, is let fall upon it, and its effect upon the metal denotes its value.

"29. Blood-stone is a very hard, compact variety of hematite iron ore, which, when reduced to a suitable form, fixed into a handle, and well polished, forms the best description of burnisher for producing a high lustre on gilt coat-buttons, which is performed in the turning-lathe by the Birmingham manufacturers. The gold on china ware is burnished by its means. Burnishers are likewise formed of agate and flint; the former substance is preferred by bookbinders, and the latter for gilding on wood, as picture-frames, &c."

THE TELEPHONY, OR MUSICAL TELEGRAPH.

In January, 1828, a M. Sudre presented to the French Academy of Fine Arts the scheme of an universal language, formed of the seven musical signs, *re, mi, fa, sol, la, si, do*, variously combined, to which he, therefore, gave the name of "The Musical Language." A Committee of the Academy, including three of the most distinguished philosophers of the age, MM. de Prony, Arago, and Fourier, reported, that after "causing several experiments to be made and repeated in their presence," they had "come to the conclusion, that the author had perfectly attained the end he had in view, namely, that of creating a *real musical language*;" and that a system of telegraphic communication might be established by means of this language, and the aid of musical instruments, far superior to any hitherto in use, inasmuch as it would enable men to correspond instantaneously with each other at great distances, not only during the most profound darkness, but under circumstances in which even in open day, no communication by visible signals could possibly be carried on.

The invention was afterwards referred by the Minister of War to a Military Commission, of which Baron Despres was President, which made an equally favourable Report upon it. After stating that, in their opinion, "the 'Musical Language' might prove eminently useful in establishing a correspondence between the different corps of an army," they give several remarkable instances in which it might have been the means of saving the French arms from discomfiture; as at the battle of Busaco, when the attack made by the French troops failed "in consequence of a division, whose march was arrested by a deep chasm, being un-

able to give immediate information of the circumstance to the other divisions from which it was separated by the abrupt winding of the mountains;" or the affair of Forroren, in 1813, when "the difficulty of communicating promptly and directly in a mountainous country" was the cause of the French army failing in its attempt to raise the siege of Pampeluna.

M. Sudre's invention was next investigated by a Commission of Naval Officers, who reported it to be their unanimous opinion, that "it would be a powerful auxiliary to the means at present used in the navy, and ought to be immediately adopted." From a series of experiments made by this Commission in the bay of Toulon, it appeared that "it only required two minutes to transmit by means of the 'Musical Language,' from one point to another, distant 9,000 feet, three orders taken from the book of signals."

The system was finally submitted to a Committee of all the five Academies of the French Institute—being now in a much more perfect state than when it was first laid by M. Sudre before the Academy of Fine Arts—and from the Report of this Committee (which was adopted by the Institute), the following are extracts:—

"The Committee are of opinion, that the 'Musical Language' invented by M. Sudre—

"1st. Furnishes a means of communication capable of expressing all our ideas.

"2d. Either by sounds or by (written) characters.

"3d. At short or long distances.

"4th. Openly or secretly (that is, by using combinations of the signs, known only to the corresponding parties).

"And, 5th. That this system of sounds is not liable, like spoken languages, to change with time, but is essentially unalterable."

* * * * * * * * *

"The TELEGRAPH can only be used at certain stations, upon heights, when every thing has been foreseen, tried, regulated before-hand and at leisure. It is impossible to make use of it without preparation, and it is perfectly unavailable under a variety of circumstances of time and situation.

"But the TELEPHONY can be put in practice on land in almost every place, by day or by night, without any change in the method, and even more easily by night, on account of the profound silence which then pervades the earth.

"This generality of application acquires additional value, when it is considered that the instrument is of the most portable description; that it is always *at hand in these very circumstances when the greatest benefits would be derived from its use;* and that the persons who make use of it for other purposes would speedily learn to apply it to the one before us; all these conditions are of the highest importance for all practical applications."

The particular "instrument" referred to in the last extract is the French horn or trumpet, which may be heard at a distance of three miles, and is that which would most probably be employed in all cases of distant communication; but of course any instrument capable of expressing the different musical signs may be made the organ of this new language.

M. Sudre is now in London for the purpose of unfolding all the details of his system to the English public; for it would seem that notwithstanding the various strong reports which we have cited in his favour, he has met with but poor encouragement from the Government of his own country. Let us hope that better fortune awaits him amongst us. His system displays in its general conception great ingenuity, and appears to us capable of being rendered very extensively useful.

NOTES AND NOTICES.

Fishmongers' Hall.—If the following statement, which appears in the *Architectural Magazine* for the present month, be correct, it must cease to be a matter of surprise that the Fishmongers' Company did not select some design for their new Hall, more worthy of the admirable site which it occupies, and of the opulence and high standing of their "gentle" craft. "The Fishmongers' Hall premiums were awarded by ——— to his own clerk, *on condition of receiving a commission from him on the amount he received as architect of the edifice.* The design was made in ————'s own office, and all the designs were sent to him for his decision as to the three best." Well may Mr. Loudon add—"If the facts are really so, the individual whose character is implicated, and is of high-standing in the profession, is *much to be pitied.*" Verily, it is no *smirking* affair.

Mr. Dean's Submarine Operations.—Mr. Dean has resumed his summer amusement of diving to the wreck of the Royal George, or any other wreck, if requisite; hooking the first thing that becomes portable, and getting it hoisted out; he has already got up eleven very handsome brass guns, and three iron ones, exclusive of some cooking materials, a bottle of wine, and sundry small articles. Last week upon a complaint made by some fishermen, that while at work on the West Flats, between Ryde and Fort Monkton, their nets were frequently broken by getting foul of some substance which was beyond their art to discover, this enterprising individual got his vessel over the spot and descended to the bottom; he there found a large piece of ordnance stuck in the mud, and, by great exertion and labour, succeeded in getting it up. It proved to be a very perfect brass cannon, about fifteen feet long; the name, "Koster, Amsterdam, 1666," perfectly legible. The ornaments are most beautiful and

chaste; the breech and trunnion is formed in a bunch of grapes. The metal is perfect and rings as sound as a bell. The shot on being drawn peeled in flakes, but the wadding was in excellent preservation. Mr. Dean is of very great use here. The other day a French whaler left an anchor in the harbour, which had got foul of the moorings: Mr. D. was employed to raise it, which he succeeded in doing, and got salvage accordingly. On groping further he got hold of another anchor worth 20*l.* He has fitted his vessel and boat for foreign service, and towards the autumn will proceed to Navarin Bay to try his luck among the wrecks of the Turkish fleet.—*Portsmouth Correspondent of United Service Journal, 20th June,* 1835.

"*Indifference of the American People to Human Life.*"—Such is the heading of a paragraph in one of Brother Jonathan's own papers, in which an account is given of two very melancholy accidents of recent occurrence—one the bursting of the boiler of a steamer called the Majestic, by which forty persons have been injured, of whom eight have died and several others are not expected to survive—and the other, the falling, in the middle of the night, of a three storied hotel, which contained at the time between sixty and seventy inmates, of whom a great many have perished (the number is not stated). "We have had repeated occasions," says the journalist, "to express our conviction, that in this country the comfort, safety, and life of man, when committed to the charge of steam-boats, stage-drivers, or builders, seems literally to be deemed of no moment. The most awful accidents from all these sources are of frequent occurrence; yet we never hear of any inquiry into the cause of them, or penalty imposed for the negligence, parsimony, or ignorance from which they almost always result. The two instances we now publish are of fearful interest; but we venture to predict, that there will be no judicial investigation in either case."

The Mathematical Instinct of Bees.—The operations of pure instinct have never been supposed by any one to result from reasoning; and certainly they do afford the most striking proofs of an intelligent cause, as well as of a unity of design in the world. The work of bees is among the most remarkable of all facts in both these respects. The form is in every country the same—the proportions accurately alike—the size the very same, to the fraction of a line, go where you will; and the form is proved to be that which the most refined analysis has enabled mathematicians to discover as, of all others, the best adapted for the purposes of saving room, and work, and materials. This discovery was only made about a century ago; nay, the instrument that enabled us to find it out—the *fluxional calculus*—was unknown half a century before that application of its powers. And yet the bee had been for thousands of years, in all countries, unerringly working according to this fixed rule, choosing the same exact angle of 120 degrees for the inclination of the sides of its little room, which every one had for ages known to be the best possible angle, but also choosing the same exact angles of 110 and 70 degrees for the inclinations of the roof, which no one had ever discovered till the 18th century, when Maclaurin solved that most curious problem of *maxima* and *minima*, the means of investigating which had not existed till the century before, when Newton invented the *calculus,* whereby such problems can now be easily worked.—*Lord Brougham's Discourse of Natural Theology.*

State of Education in England.—From a summary, prepared by Mr. Rickman, of the Returns made to the House of Commons, on the motion of the Earl of Kerry, it appears that there are 4,000,000 of persons in England, under 16 years of age, and only 1,200,000 receiving daily education. If we allow half a million for the number of persons under 2 years old, and also a similar deduction for those who at an early age receive the rudiments of education in the nursery, and those of the richer portion of the community, who receive what is termed home education, there will still remain above 2,000,000 individuals, who both for their own sakes and the sake of society should receive instruction, but who are entirely destitute of its advantages.

Mr. Watt, the Discoverer of the Constitution of Water.—Lord Brougham, in his "Discourse of Natural Theology," after noticing the experiments of Dr. Priestley and Mr. Cavendish, by which they proved, that by burning oxygen and hydrogen in a close vessel, they disappear and leave a weight of water equal to their united weights, observes:—"Dr. Priestley drew no conclusion of the least value from his experiments. But Mr. Watt, after thoroughly weighing them by careful comparison with other facts, arrived at the opinion, that they proved the composition of water. This may justly be said to have been the discovery of that great truth in chemical science. I have examined the evidence and am convinced that he was the first discoverer in point of time, although it is very possible that Mr. Cavendish may have arrived at the same truth from his own experiments, without any knowledge of Mr. Watt's earlier process of reasoning."

Draining by Boring.—The plain of Palins, near Marseilles, used to be a great morass. It appeared impossible to drain it by the help of the common surface-channels. King René, however, caused a great number of pits or drain-wells to be sunk, which are known in the Provençal language by the name of *embugs* (funnels). These pits transmitted, and now transmit, into the permeable strata, situated at a certain depth, those waters, which anciently made the whole country a barren waste.

Cooking by Gas.—Extract from a letter of Mr. John Barlow, C. E., to a friend in America, dated Feb. 27, 1835:—"There is one source of revenue to a Coal-Gas Company coming into practical effect here which promises to be of great importance, namely, cooking by gas. I know one family who have used no other fuel for cooking for the last two years—and another who, for several years, have never lighted any other fire in their house for any other purpose whatever than gas during the three or four hot months; and they both say it is cheaper, more convenient, cleanlier, and the cooking better. Hundreds, and probably thousands, of families will in this country, be supplied with gas for cooking during the ensuing summer. They now roast bake, and boil by gas. The heat is always ready when wanted, and is extinguished when it is no longer required; no dust, no preparation, nor any cleaning up afterwards; the cook can leave a joint of meat, either roasting or boiling, and never look at it again till the clock informs her it is time to take it up. I know a family who regularly put their meat down, and all go to church on Sunday, locking the house up and leaving a capital dinner to the care of the gas."

Bath Hot-Wells.—Of the manner in which charities have been administered under the corrupt (Corporation) system about to be destroyed, Bath affords a curious and instructive illustration. Bath is favoured by nature with a supply of hot water sufficient to enable every inhabitant of the town to bathe every day. The Corporation has been for years composed chiefly of medical men, who know, or ought to have known, the immense importance to the health of the population of the cleanliness derived from constant bathing. But this Corporation cared nothing for the health of the people; so they made very fine baths, demanded a heavy fee for bathing therein, thus excluded necessarily nine-tenths of the population, and let the

warm water nearly all run to waste.—*Mr. Roebuck's Letter to the Electors of Bath.*

The Liverpool and Manchester Railway locomotive-carriages are of three kinds, and are called train, luggage, and bank-engines. The *train*-engines average about 30 horses' power; they weigh about 8 tons, and cost about 900*l*. The *luggage*-engines are, in general, 35 horses' power, and weigh about 9 tons; they cost about 1,000*l*. There are only two *bank*-engines, the Goliah and the Samson, which are used for assisting the trains with passengers and luggage up the inclined planes at Whiston and Sutton; they are about 50 horses' power, weigh about 12 tons, and cost about 1,100*l*. The Company have had altogether 32 locomotive-carriages made, but five or six are now (Feb. 1835) out of use, and many of those at present on the road have been almost totally renewed. They generally run about 18 months before receiving a renewal or thorough repair. The Vulcan, a train-engine, ran no less than 47,000 miles before it required to be repaired; and the Firefly ran 50,000 miles. The greatest speed which the engines have been able to obtain on a level is 60 miles per hour, without a load. The Planet, with her tender, went from Liverpool to Manchester in 40 minutes, being at the astonishing rate of 45 miles per hour, *including* time lost in stoppages and ascending the inclined plane.—*Mr. David Stevenson: Scottish Society of Arts' Transactions.*

Balloon Communication between London and Paris.—We perceive that the grand aerial project which occupied so much of the attention of the Parisian quidnuncs about this time last year, is revived—with this difference only, that the scene of operation, or to speak more properly, perhaps, the starting-post, has been shifted from Paris to London. The projectors who have now taken unto themselves the style and title of the "European Aeronautical Society," announce in the newspapers that their "first aerial ship the Eagle, 160 feet long, 50 feet high, and 40 feet wide," and which is to be (?) "manned by a crew of seventeen persons," may be inspected at a certain *dock* in the neighbourhood of Kensington, previous to making its first trip "from London to Paris and back again;" after which it is to make similar trips to Brussels, Amsterdam, Berlin, Munich, Madrid, &c., till the practicability of establishing an aerial communication between London and the other capitals of Europe, is fully and incontrovertibly demonstrated! The scheme is, after all, only a copy, and that but an indifferent one, of a plan that was proposed as far back as 1796, by an engineer of the name of Campenas, and not only entertained by the French government, but sanctioned by that select body of *savans*, the French Institute. Campenas wrote a long letter to Bonaparte, then General-in-Chief of the army of Italy, from which we extract a paragraph or two. "*General Citizen*,—The artist who addresses you, filled with the most lively gratitude, will erect, if the means of execution be afforded him, a vast edifice, whence, at the conclusion of his labours there will issue an Aerial Vessel capable of carrying up with you more than 200 persons, and which may be directed to any point of the compass. I myself will be your pilot. You can thus, without any danger, hover above the fleets of enemies jealous of our happiness, and thunder against them like a new Jupiter, merely by throwing perpendicularly downwards firebrands made of a substance which will kindle only by the contact and percussion at the end of its fall, but which it will be impossible to extinguish. Or perhaps you may think it more prudent to begin at once by forcing the British cabinet to capitulate, which you may easily do, as you will have it in your power to set fire to the city of London, or to any of the maritime towns of England. From the calculations I have made, I am convinced that with this machine you may go from Paris to London, and return back again to Paris in twenty-four hours, without descending. The object I propose is to establish in the great ocean of the atmosphere a general navigation, infinitely more certain and more advantageous than maritime navigation, which has ever disturbed the tranquillity of mankind—to restore the perfect liberty of commerce, and to give peace and happiness to all the nations of the universe, and unite them as one family. By great labour I have surmounted the multiplied obstacles which presented themselves before me; and my progressive discoveries are developed in a work which I have prepared, consisting of about 400 pages, and divided into five parts." How lucky for England that the "new Jupiter" had other things on hand, to divert his attention from this most appalling (though not more appalling than sensible) scheme of national destruction!

Cold and Hot Blast-manufactured Iron.—"I observe that Mr. Glynn of the Butterley Iron-works, promises to send you for inspection specimens of hot-blast manufactured iron, in order to do away with the prejudice existing against this description of iron, on account of its supposed deficiency in strength. Permit me to offer a suggestion to Mr. G. and yourself, with respect to the sort of experimental proof that would be fairest to all concerned. Let Mr. G. take indiscriminately from two lots of cold and hot blast manufactured iron bars, one of each—try himself their comparative strength—and report to you the results. Let him then forward two other bars, also taken indiscriminately from the same lots—having care only that they are of the same sectional area and weight—and let these be tested here by the Editor in the presence of any two or more scientific persons he may choose to invite to his assistance. The results of the two experiments ought, of course, to correspond nearly, and should they be only as favourable to the hot-blast iron as the Staffordshire masters would have the public believe, Mr. G. will have no occasion to regret his compliance with this suggestion." M., 27th July, 1835.—The number of specimens proposed to be tested, is rather limited—two or three of each would be better; but with this exception, we think the mode of proceeding, suggested by our correspondent, would be entirely satisfactory.—*Ed. M. M.*

"A Sufferer" had better forward a statement of his case to Lord Brougham; but, according to his own account, his specification was not so "perfect as it *might*," and therefore *ought* to have been.

Communications received from R. E.—M. F.—Mr. Walford—R. M. D.—Philanthropist—H. C.—Cornubiensis—A Poor Inventor.

Our Publisher will give One Shilling and Sixpence for copies of the Supplement to Vol. IX.

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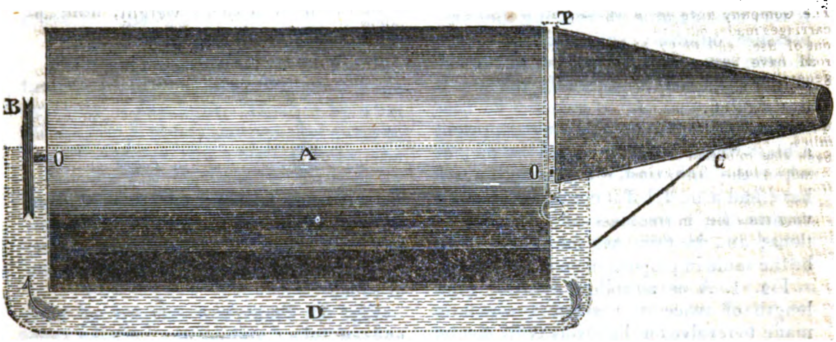
HYDRAULIC BLAST-WHEEL.



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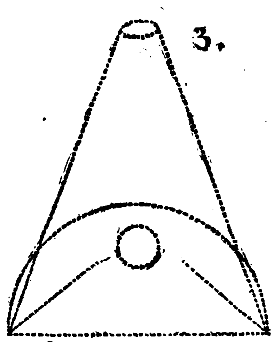

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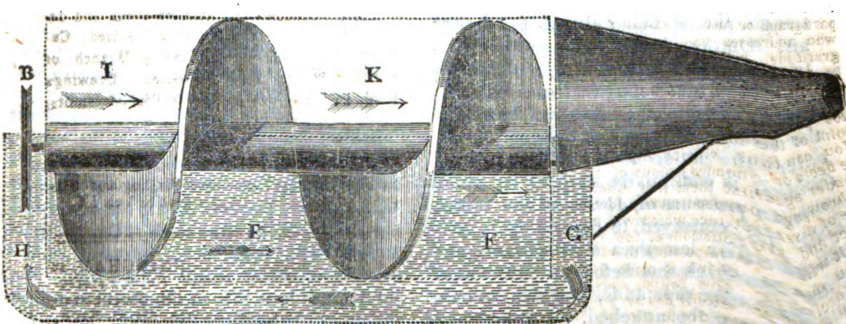


HYDRAULIC BLAST-WHEEL.

In founderies, smithies, and other manufactories, large quantities of atmospheric air in rapid motion are in constant demand, and a large proportion of the motive-power is spent in the supply. The pressure of fluids being equal in all directions, the aggregate amount of force employed in transmitting air by means of bellows, air-cylinders with pistons, &c., is very considerable, there being the same pressure on every square inch of the blowing-apparatus, as on the like space of the orifice through which the air is transmitted.

The accompanying drawings represent a blast-wheel lately invented by me, of which the following is a description. I have had a model of it made, and it fully verifies the correctness of my calculations; and in this case the effects must be the same in proportion on a large scale.

Fig. 1. A is a hollow cylinder (the length of twice its diameter), which is made to revolve on the pivots O by means of a rope or belt acting on the pulley B, or by any other mechanical power. C is a stationary nose or tube, fixed to the side of the oval trough D. The trough is nearly full of water, its level being above the centre of the cylinder A, and of the small cylinder within it, hereafter described. Within the cylinder A is a spiral leaf wound round a cylinder of about ¼th of the diameter of the external one. The size of the internal cylinder need not be increased in proportion to that of the external. The leaf is soldered to both cylinders, and so rendered air-tight; it may be made of the slightest material.

Fig. 2. The water is here seen occupying the lower half of the cylinder and trough, the top being always filled with air. On the wheel's making one revolution, the water in E is conveyed into F; that which was before in F escapes at G, and flows round the sides and bottom of the trough, outside the cylinder, to reenter the latter at H. The air in I (which is continually supplied by atmospheric pressure of 15 lbs. to the square inch) is conveyed to K, and so in proportion for less than a revolution; and the air which was before in K is forced through the pipe at C, to which branch-pipes may be attached. A continuous blast of air is thus produced, and may be conveyed to any part of a building. The pressure of the water being equal on all sides; and as it is set in motion by the inclined plane of the screw, but little power is required to keep the wheel going, for the particles of fluids move easily amongst themselves. The trough should be of an oval form. In order that no air may escape between the tube and the cylinder, a small strap of leather is fastened to the tube (which is fixed) to lap over the cylinder at P, fig. 1, and is kept down by a small weight, hung at the corner of each side, thus,

No air, once enclosed or detached from the atmosphere by the end H of the spiral leaf being immersed in the water, can possibly escape but through the nose or tube.

Fig. 3. Transverse sections of both ends of tube; and outline, as seen from its under side.

The wheel may be made of any size required. To ascertain the quantity of air discharged at each revolution:—First, find the whole contents of the cylinder, which we will suppose to be 14 feet in diameter, by first finding the area of the base by multiplying the square of the diameter by ·7854; then multiply the area by the length of 28 feet, thus, $14 \times 14 = 196 \times {\cdot}7854 = 154$, nearly, $\times 28 = 4312$, contents of cylinder. But as it takes two revolutions to empty the cylinder, $4312 \div 2 = 2156$ feet of air and water discharged at each revolution, $2156 \div 2 = 1078$ feet of air less 78 feet for internal cylinder, &c. $= 1000$ cubic feet of air discharged at every revolution. If the motive-power, or the velocity, cannot be easily regulated, a sliding-valve may be made in the side of the tube C.

Alfred T. J. Martin.

Helston, Cornwall, June 6, 1835.

P. S.—Since writing the above, a practical difficulty has been suggested to me, viz. that the pressure of air for smelting should be 2, 3, and even 4 lbs. to the square inch, equal to the pressure of a column of water about 7 feet high. I do not see how this desideratum can be obtained by the foregoing plan; but still the invention may prove useful where large supplies of air are required without any considerable pressure.

ON RAILWAYS. BY JOHN HERAPATH, ESQ. NO. VI.

Unless one has mixed much in railway discussions, he would scarcely credit the absurd and preposterous notions which are attempted to be foisted on the public in regard to tunnelling. It is for the purpose of considering some of the objections to this unnatural burrowing, somewhat more in detail than I heretofore have, that I now recur to the subject.

Of the Lighting of Tunnels.

It has been gravely talked of lighting tunnels artificially, so as to supersede the necessity of day-light. How or by what means this is to be done remains a secret. To philosophers and practical men, the hopelessness of approaching the solar by any artificial light is well known. Sir John Leslie computes, from experiments, that a piece of the sun's matter less than half an inch diameter would give more light than 12,000 wax candles; and every light we know of, even the hydro-oxygen light I am informed, the most intense by far yet discovered, sinks into a dark spot when held up before the sun's disk. It has been computed by Bouguer, that the light sent us by the sun exceeds that by the full moon 300,000 times. Coarse as our optical nerves are in judging of degrees of light, it would, therefore, be impossible to have a sudden transition from solar to lunar light without producing the sensation of great darkness; and it is only to the slow and insensible gradations, first of the descending sun, and then of twilight occupying at least an hour, that we are enabled to bear so great a difference. But what would be the time of passing from broad day-light, with a train in full speed, to the intense darkness of a tunnel—a single second? Not more if the velocity was 30 miles an hour; for in that space the train would go 44 feet. Any one, therefore, may judge for himself of the effects of so instantaneous a transition from the full light of day to that of the full moon, could such a light, and so diffused, be introduced into a tunnel, which I apprehend to be impossible.

But it is well known, that any object not illumined directly by the sun depends for its visibility on the indirect light falling on it from all visible points, especially from that portion of the sun's rays intercepted and diffused in every direction by the particles of the atmosphere; and that the more this indirect light is diminished the darker the object grows. Hence it is, that in descending an uncovered well or pit, the indirect light is gradually curtailed until it is too weak on the eye to resist the feeble light of the stars, which become visible, though that indirect light comes from a column of atmosphere 30 miles high illumined by the sun. On the same principle, too, it is, that when the eye is protected from the indirect light by a long tube, darkness so increases on it that the stars may be seen as well as in a pit. So also on the Andes, the brighter planets and stars may be detected in the day, which happens on account of almost half the indirect light being there lost by these lofty mountains rising above nearly half the actual substance of the atmosphere, though to scarcely a tenth of its altitude.

If, therefore, the visibility of bodies depending on Nature's most powerful light, diffused by the whole extent of the atmosphere, is so very easily destroyed, how is it possible in the contracted limits of a tunnel, boxed up besides in a coach, any artificial light, far inferior to the sun's, can cause that luminous diffusion needful to produce general visibility of objects? The idea is too absurd to be uttered by any one not interested in propagating it. That a tunnel can be so lighted that a person may walk in it, is obvious; but in carriages it would be light where the lights fell, and intense shade where they did not. I have myself walked up and down the Liverpool short tunnel, about 340 yards (if my memory is correct), without much inconvenience; but when I entered it in a train, impenetrable darkness ensued, disturbed now and then by the gas, whose sickly and jaundiced hue seemed calculated only to render the horrors of the place more apparent.

It has been hinted to me that Mr. Stephenson, the engineer, intends to light his tunnels so as to do away with the objections to the want of day-light. I should be glad to see it; but I cannot believe that Mr. Stephenson, who is often styled "the Pope of Engineers," could give rise to so silly a report. That Mr. Stephenson is an industrious, ingenious man, no one can doubt; but to say that he claims to be able to do that which men much more conversant with the subject judge to be impossible, is to throw an odium on him for arrogance and presumption, which I cannot imagine he

merits. I would as soon believe Mr. Stephenson had declared his possession of the Laputan philosopher's desideratum, namely, a method of bottling up the summer sun's rays to grow cucumbers with in winter.

What has been said, presupposes the atmosphere of the tunnels perfectly clear and transparent; but the moment an engine enters, the confined air will be intermingled with a vast volume of dense steam and smoke. And since each succeeding engine will add to the nuisance of its predecessor, I should be glad to learn how a tunnel of any length is to be cleared, if there be much traffic on the line, and by what legerdemain Mr. Stephenson will undertake to send his light through such an atmosphere. Would it not savour more of sober reason, at the end of each tunnel to provide the means of ablution from the filth the poor passengers had contracted, with an antidote of some kind to neutralize the smoke and steam they had swallowed, and a cordial to revive their exhausted spirits?

Of the Permanence of Temperature in Tunnels.

About 80 feet under the surface experiments have shown that the temperature varies seldom more than a degree all the year round. This, therefore, presents another serious objection to tunnels. For as tunnels are seldom made unless the superposed ground exceeds 80 feet, it follows, that the temperature of them cannot differ much from the mean temperature of the soil, or 51°, at any season of the year. A person, therefore, leaving the external air of a hot summer's day, may change an open dry air for a damp cold one, perhaps 30°, 40°, or 50° lower. Now, if any time was spent in the tunnel, or if accident should detain the train, this would be no trifling change so suddenly made to any constitution. A miniature effect of it may be felt in St. Paul's in a hot day, by a cold current of air about the ankles. But I have heard that in the Thames tunnel, which Mr. Canning very significantly denominated "a great bore," the sensation is very chilly and unpleasant. However, as the air is a weak conductor of heat in respect of quantity, though it transmits it rapidly, that is, at the rate of 1100 feet per second, it is possible in the passage of quick trains the change within the carriages would not be so much felt. But there is another point in which the constancy of temperature in tunnels would have a very powerful and, I fear, a very pernicious effect. I allude to the

Ventilating of Tunnels.

Tunnels for locomotive-engines must evidently be horizontal, or so nearly so that they could never ventilate themselves. Omitting the perpetual liberation of vapour from the sides and ground of the tunnel, which, if it was only to render the confined air thoroughly damp, is bad enough, the incessant escape of gas, and, much more, the decomposition of the atmosphere and destruction of the vital part of it by the lights, would soon render the air totally unfit for human respiration. These effects would be more marked and serious as the tunnel is longer. Various methods, therefore, have been proposed to insure that constant supply of pure air indispensable for comfort and safety. The most approved, I believe, is that by vertical shafts from the tunnel to the top of the ground. In winter these may answer, so as to cause a circulation. The external air being then much colder, and, consequently, heavier than the internal, would force its way in at both extremities, driving the impure lighter air up the shafts. Or the external air may descend in the middle of a shaft, round the sides of which the internal air is ascending, and by that means keep up a steady circulation, though not a pure air. But how would it be in the height of summer, when the temperature of the internal air falls considerably under that without and above. Before any disposition to change can arise, the internal air must become specifically lighter than the external, which can happen only by admixture with a sufficient quantity of the noxious vapour of the tunnel, or of the gas which lights it. That is, before any tendency to circulation can occur, the air must be surcharged with pestilent vapour and deadly gas; and this at a season of the year, too, when pure air is most needed, and our bodies are most obnoxious to disease. Let the medical man, who knows that an inspiration or two is often sufficient to implant the germ of incurable disease, say whether such a state of things should be allowed.

Mr. Stephenson, in his evidence in the House of Lords the other day, I am informed, stated, "he could see no objection to a tunnel 20 miles long." Having given his opinion on oath, we are bound

to admit he believes it. But is Mr. Stephenson philosopher enough to know the *modus operandi* of matter?—has he medical skill to determine the precise limits to which we may go without deranging that most delicate of all balances, the balance of health?—or does he think his notions of what is, or is not, objectionable, are to be the standard and law of the world? If not, on what grounds does he presume to give such an opinion? Mr. S. will pardon my telling him so, but such imprudent assertions will presently lead Englishmen to believe, that his knowledge of nature is about equal to that of his brother in title, Pope Callixtus, who solemnly excommunicated, with his enemies the Turks, the comet expected next month, because, from its tail resembling their scymitar, his holiness thought the poor star had come to aid and partake of their devastations.

Of the Smoke, Noise, &c. in Tunnels.

Until very lately I was not aware there was any tunnel in which a locomotive-engine dragged a train with passengers. I hear there is one of about 800 yards between Leeds and Selby. A gentleman who had been through it thus described it to me. "We were immediately enveloped in total darkness, and every one of the carriages filled with smoke and steam to a most annoying degree. Though we were but a few minutes going through, such was the nuisance, we thought it an hour." He was there once, too, when the train struck against some scaffolding, which had been used to whitewash the tunnel. "The crash," he said, "sounded terrible; and the turning off of the steam," which, I think, in the open air, would barely have been heard inside of a carriage, "resounded like the report of artillery; and both men and women were so alarmed and frightened, that they declared their apprehensions of immediate death."

This is a specimen of tunnel-travelling with locomotive-engines. Let every one decide for himself whether they are nuisances or not, and whether from this one sample of one of half a mile, he can agree with Mr. Stephenson in seeing no objection to tunnels 20 miles long. Surely, some men see their reasons through golden per centages, and draw their arguments from profits. It is to be hoped, however, that the Legislature will see this matter in a true and just light; that they will consider the objections there ever must be to tunnels, the nuisances they will be to the public, the extravagant expense of their construction, the certainty of such lines being ultimately superseded by other lines without tunnels; and that they will really prove themselves the guardians of the subscribers and friends to the public, by setting their faces against any bill in which tunnels are proposed. By this means they will confer a real benefit on the present and future generations, while the only injury they can do, will be to prevent a few engineers from amassing large fortunes by their per centages on sums, needlessly drawn from the public, and uselessly and ruinously wasted. That good working lines for railways, to most of our great towns, can be found free from tunnels, I have been informed, and have no doubt of it; why then should they not? Colonel Landmann and Mr. Cundy have set engineers an example, which it would be well for the public if others were compelled to follow, and would save the destruction of millions of money.

My observations, I hope, will not be understood to have any hostile feeling towards the "Great Western Railway." That Company have fought right manfully for their bill, and deserve it. Besides, a railway is absolutely needful to Bristol. What I should be glad to see, if it were possible, is, that in their bill the engineer, at his own expense, be compelled to find the Company a line free from such fatal objections as tunnels, which, I think, might easily have been done, and would, had a right method been pursued.

I have said nothing of the consequences of tapping springs in tunnelling, simply, because I did not wish to swell the catalogue of objections and dangers. But men of discernment will soon see, that a pressure, which amounts to half a pound for every foot of perpendicular altitude of the origin of the spring, that is, if it be 480 feet high, of 1 cwt. per square inch, 1 ton 2½ cwt. on the edge of every brick, or 7 tons 4 cwt. on every square foot, is not to be lightly passed. Neither is this destruction of springs to be disregarded, which may cause irreparable mischief many miles off.

John Herapath.

Kensington, July, 1835.

COW'S PORTABLE INDIA-RUBBER BOAT.

Sir,—In your journal of the 20th June last, a correspondent makes mention of an India-rubber boat which was constructed by Mr. Cow, of his Majesty's Dock-yard, Woolwich, in 1829, that is several years before the Americans, who now claim the honour of the invention, ever imagined, or, at least, produced any thing of the sort, and reference is made to a treatise on boats by Mr. Cow, in which the subject is treated of at length. Having in my possession a copy of Mr. Cow's work, I have made an extract from it, which I now send you, of the part relating to the India-rubber Boat, in the hope that you will in justice as well to a most ingenious individual as to a very useful invention, give it a place in your widely-circulating pages.—Yours, &c.

T.

On the construction of a Portable Boat for landing and embarking the Horses attached to a Field Gun, or Cavalry of any description, on a beach and through a surf.

One of the most pleasing circumstances resulting from my endeavours to introduce improvements in boats is, that of giving me an opportunity of conversing with officers of rank and experience, and thereby obtaining the necessary information for carrying on the several public services, and what alterations would be desirable in them, could they be effected; a species of information which, from my station in life, I could have no means of obtaining by my own observation. It was during a conversation with Captain M'Kinley, R.N., (who has frequently done me the honour to inspect my propositions,) that he mentioned the difficulties that usually arise in landing or embarking horses on a beach, should there be any surf; and he also particularly stated what took place at the Helder, 1799, when after the General (Sir Ralph Abercrombie) was landed, it was found impracticable for a considerable time to get a horse on shore for his use, which he was exceedingly anxious to effect; it being of the greatest importance that he should be mounted. It was at length accomplished by a captain in the navy, who volunteered his services, and mounted the horse, and swam him on shore through a great surf, at the imminent risk of himself and horse. This conversation forcibly impressed on my mind the necessity of some plan to accomplish this object; and it also occurred to me, that could it be effected, it would be a most essential addition to my proposition for landing the mounted field-gun, as then the horses attached to the gun might be landed at the same time, and under the same circumstances of weather and surf. I, in consequence, set about making the most diligent inquiries, not only at the model-room of the Royal Military Repository at this place, but also of all the officers, old soldiers and sailors with whom I could communicate, as to whether there was any established method of performing this service; and if not, what means were generally resorted to.

Although there are models at the Repository, showing the manner in which horses are hoisted in or out of transports when alongside of a wharf, I could not discover any which applied to the landing of them on a beach; and all the information I could collect was, that they were either placed in flat-bottomed boats, or that two long boats from the transports were lashed together, and a platform laid on them, with stanchions and a guard rope to prevent the horses from going overboard. It must be evident that should the surf extend any distance from the shore, it would be utterly impossible to accomplish the object by either of the methods here mentioned, and the only resource left would be, to get the transports as near as possible to the beach, to hoist the horses out, and swim them on shore; the risk of drowning or laming the horses by this mode must be apparent. Admitting it to be possible to swim horses on shore under those circumstances, I conceive it would not be practicable to embark horses in that manner: for, in the first place, it would be most difficult to get them to take the water through the surf; and even should they be got off, there would be still a great difficulty in slinging them to hoist them in. I am informed that in the retreat from Corunna, in 1809, there were a number of valuable horses in the town the night before the battle; and although there were transports in the bay, yet, from the want of means to embark them, the whole were destroyed.

It may also be stated that the flat-bottomed boat is considered a great evil on board a ship of war or transport; it is very heavy to hoist in or out, and it occupies a large space on a ship's deck; or should they be placed on skids over the quarter-deck, they are, from their elevated position, a great encumbrance.

In order to overcome these difficulties, I constructed a model, of which the following is a description.

My first object was to devise a portable boat, one that might be easily taken to pieces, and stowed away in a comparatively small space, and which might be put together, not only with facility, but by any description of men. During the time I had the superintendence of the building of the boats for Captains Franklin and Parry's northern expeditions, I had frequent opportunities of observing Macintosh's patent water-proof canvas; one boat was built and covered with

it in this dock-yard,* and one by Colonel Pasley, Royal Engineers, at Chatham, for Captain Franklin's overland expedition; and I was strongly impressed with the idea, that a canvas of this description, but much stronger, and finished in a different way, might materially assist me in making the boat portable.

The form of the boat became the next consideration. It was desirable that it should be such as would be best calculated to encounter a surf, and not longer or broader than to contain four horses (which number appeared sufficient to land at a time), and to be of such a depth as to preclude the possibility of the horses springing out. I am sanguine in the belief that I have been successful in the form, as it respects encountering a surf, as I am told she resembles the Massulla boats of Madras.

In order to make the boat portable, and to do it in as simple a manner as possible, the different parts of her frame are connected by iron screws and brass nuts; the screws are so made that they may be turned in by hand, consequently no tools are required, and she may be put together by any men of common understanding. To facilitate which, the four quarters of the frame of the boat are painted of different colours, and marked; therefore it is almost impossible to err; the screws also are all cut with the same die, and the only precaution necessary is with regard to their length. The boat is constructed with a flat floor, and there is a strong platform for the horses to stand on, which is carried sufficiently high to prevent the possibility of an accident; there are three thwarts at the proper height, for the security of the boat, and parting bars are placed on the gunwales, to keep the horses separate and steady. When the frame of the boat is put together, a water-proof canvas covering is put over it, and laced to the gunwales, when she becomes a perfect boat.

As it is intended to draw the boat up and down a beach, it becomes necessary to protect that part of the canvas which may come in contact with stones or uneven ground; therefore she is placed on a sledge, which will keep her nearly a foot from the ground, and also perfectly upright and steady when hauled up.

The boat is twenty-four feet long, eight feet six inches broad, and four feet deep, and when taken to pieces, it may be packed (with the exception of the keel and gunwales) in two cases, each ten feet long, two feet six inches broad, and two feet deep; and is not only competent to carry four horses, but also their harness, and whatever stores may be necessary.

When it is required to land horses, the boat is to be put together on the ship's deck, and hoisted out, the horses must be lowered into her, and secured in the usual way; the boat is then transported as near to the beach as the surf or local circumstances will admit of; a rope previously fastened to the sledge is got on shore, and a sufficient number of men will haul her through the surf and half her length up the beach: the canvas at the fore-part of the boat is then unlaced and rolled under the bows, the screws at the scarphs of the gunwales, at the risings, footwaling, and keel (ten in number), are taken out, when the fore-part of the boat may be removed, and the horses can walk out.

As I have not seen the boat hauled up with horses on board, I am unable to state the number of men necessary to perform it, but I consider it will require between forty and fifty men. When the first four horses are landed, they may be made to assist the landing of the remainder.

When it is required to embark horses, the boat is put together on the beach, the horses led into her, the bow closed up, and with the assistance of an anchor or boat, moored without the surf, she is heaved afloat.

On the 26th of November, 1827, I had the honour to submit and to explain my model to the Honourable Navy Board, who declared themselves perfectly satisfied with it, and ordered a boat to be built on the above principle in this dock-yard, which was done, and examined by his Royal Highness the Lord High Admiral, as well as by many distinguished officers of the navy and army, and it was subsequently sent to Portsmouth for trial on South-Sea beach, but I have not heard that an opportunity has yet offered for doing so.

From various experiments which I have made on the strength and water-proof qualities of the canvas used for the covering of this boat,* I feel justified in stating that it may, and that it will be used for many important and highly useful purposes, particularly as connected with the naval and military services. It occurred at the battle of Navarino, and also in many actions during the last war, that, at the conclusion of the engagement, the boats when required to board the prizes were found to be so perforated with shot, that they would not swim, and a considerable time elapsed before they could be made effective; and I have heard that many prizes have been lost in consequence of this state of the boats. This was distinctly the case in the defeat of the combined French

* Captain Franklin did not take this boat.

* This manufacture being composed of two pieces of cloth, united by a solution of Indian-rubber, is of immense strength. The canvas used for this boat was prepared by Mr. Thomas Hancock, who manufactures this article (for Messrs. Macintosh and Co.) in London, and was quite a specimen of the perfection to which this mode of water-proofing has been brought.

and Italian squadrons near Lissa, in March, 1811, by the squadron under the command of the late Sir William Hoste. Sir William states,* "I must now account for the Flora's getting away after having struck her colours. At the time I was engaged with that ship, the Bellona was raking us, and when she struck I had no boat that could possibly take possession of her." Also at the capture of the Rivoli by the Victorious, in the Adriatic, in April, 1812, the latter ship's boats were so much injured, that they would not swim, and the prize was boarded by Lieutenant (now Captain) Peake, and one man, in a dingy.

Now if every ship of war was supplied with a covering of this description, previously fitted to one or more of her boats, which covering might be kept below until wanted, however much the boat may be hit with shot, or staved, (provided her form was not entirely destroyed) by placing this covering over her, she becomes in less than two minutes an effective boat, and fit for any service.

In obedience to directions from his Royal Highness the Lord High Admiral, a small boat was built in this dock-yard, on the principle of the horse-boat: she was twenty feet long, five feet ten inches broad, and two feet two inches deep, weighed five hundred weight two quarters, and was packed in two cases, one fifteen feet long, fourteen inches broad, and nine inches deep; the other six feet one inch long, one foot ten inches broad, and one foot four inches deep. This boat was taken in the yacht on his Royal Highness's visit to Portsmouth and Plymouth in July last, and was put together at each of those ports, when thirty men were embarked, and she was rowed round Plymouth harbour with that number of men. Not the least weakness was apparent, and not a drop of water came into her. She was subsequently sent to Portsmouth for his Majesty's ship Madagascar, at the request of Captain the Honourable Sir Robert Spencer. Also, two boats, similar to the one supplied to the yacht, have been built for the settlement at the Swan River, Western Australia.

For military purposes I feel confident that portable flying bridges, on the principle of those at Antwerp, and at several towns on the Rhine, might be constructed in this manner with great advantage, and when made light, and suitable to pack in a small space, might be eminently useful to an army.

Perhaps I ought to apologise for presuming to speak on military subjects; and I must again observe, that I pretend to no other knowledge than what I have collected in conversation with experienced officers, and from reading. In Sir Walter Scott's History of Bonaparte, there are many passages which strengthen my statement, viz. that circumstances have arisen where boats constructed in the manner above described would be exceedingly useful. In vol. iii., p. 119, Sir Walter states, that "Bonaparte himself observed that the passage of a great river is one of the most critical operations in modern war." Page 122.—"They had to pass (the Po at Placenza) in common ferry-boats, and the crossing of the advanced guard (five hundred men) required nearly half an hour; so that the difficulty, or rather impossibility of achieving the operation, had they been seriously opposed, appears to demonstration."

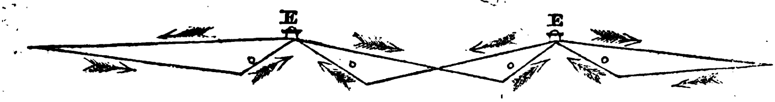
"The vanguard having thus opened the passage, the other divisions of the army (between fifty and sixty thousand men) were enabled to cross in succession; and in the course of two days, the whole were in the Milanese territory, and on the left bank of the Po."

But perhaps the most striking case is mentioned in vol. vii., p. 212, when treating on the advance of the French army towards Moscow:—"The river Willia being swollen with rain, and the bridges destroyed, the Emperor, impatient of the obstacle, commanded a body of Polish cavalry to cross by swimming. They did not hesitate to dash into the river, but ere they reached the middle of the stream, the irresistible torrent broke their ranks, and they were swept down and lost almost to a man."

* Vide London Gazette, May 18, 1811.

QUICK AND CHEAP MODE OF RAILWAY TRANSIT WITHOUT LOCOMOTIVE-ENGINES.

Mr. Editor,—A great deal has been said on both sides for and against the undulating railway principle, but hitherto no satisfactory practical results have been obtained on which to found a definitive judgment respecting it; and although the shareholders of the Liverpool and Manchester Railway are deriving considerable profits, owing to the immense traffic between the two towns, still there are doubts if many other roads will pay at all, the expense of locomotive-engines being so great wherever there are considerable inclines to be overcome, and the first expense of constructing the railway so enormous, from the endeavours made by tunnelling and embanking to reduce that expense. I am, therefore, induced to send you a new plan of an undulating railway, by which locomotive-engines (except on very rare occasions, indeed,) will be dispensed with; the trains will travel by the force of their own gravity from station to station, as described in the following diagram:—



E E are stationary steam-engines, and O O O O inclined planes by which the stationary engines bring the trains up to a level; when the trains, going and returning, take the roads the arrows point to. I have no doubt but in many situations falls may be obtained each way for miles together. Deep cutting and tunnelling would be thus, in a great measure, dispensed with; and if tunnels in some situations were absolutely necessary, by giving them the required falls for the trains to go through them, by gravity alone, travelling through them would not be disagreeable, as no engine would go with the trains.

I am, Sir,
Your obedient servant,
THOMAS DEAKIN.

Blaenavon Iron-Works, June 5, 1835.

MR. WOODHOUSE'S ANGULAR RAILWAY BARS.

Fig. 1.

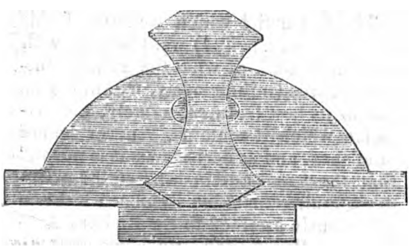
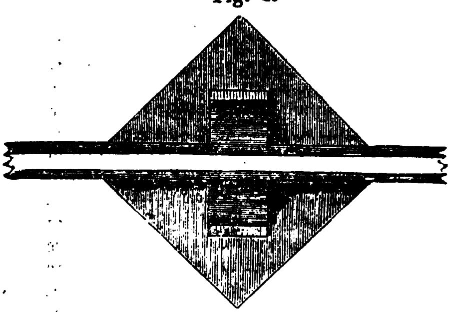


Fig. 2.



Sir,—As the form of rails best suited for affording safety, economy, durability, &c. has occupied the attention of many scientific persons, and formed the subject of several communications in your pages, I hope, without presumption, I may be permitted to propose the following as a plan, in my humble estimation, calculated to effect these objects.

Some few months since (No. 572), I proposed the use of an angular rail; my plan was not then matured, but as I have since given some little attention to the subject, I send you the results.

The purpose of giving an angular shape to the rail is, that the engine wheel (also having an angular grooved rim to correspond) may have a greater hold upon the rail, thereby giving greater efficiency to the power of the machine, preventing an irregular action, which must be produced when the wheel slips on the rail (a circumstance much alluded to at the opening of the Selby Railway), and thereby much strain to the machinery. The top surface, one inch broad, is intended for the train-wheels, and where friction would be a defect, it is thereby avoided. The form of the rail is intended to admit of being reversed at any future time when the upper surface is worn. The chair is not intended to be fixed, but the central part, which projects downwards, is to let into the stone sleeper, and be bedded in with cement or not, as found best. The rail is not fixed to all the chairs, but only to the centre one; which proposition I made with another plan of Rail and Chair sent to the *London and Birmingham* Railway Directors. The size of the present rail is as follows:—Depth, 4¼ inches; extreme width, 2¼ inches; surface, 1 inch; angles, from 15 to 25°, as the friction is required; the calculated weight is rather more than 51 lbs., but upon shrinking, it would probably not be more than 50lbs. to the lineal yard.

It has been objected to turning the rail when one side is partially worn down, that in proportion as it is so worn, its strength must be diminished. But as

long as the internal structure of the rail is not so permanently injured as to prevent its return after deflection to its original horizontal form, it seems to me that it must be nearly, if not to the full, as efficient as ever.

As respects the supporting of the rails, I also proposed that instead of having the rail resting solely upon the chair, the chair should be so planned, that the rail should also rest upon the surface of the stone, whereby it would be strengthened, and the stone, by receiving a steady vertical pressure, would be rendered less liable to the casualties so frequently complained of.

I also proposed that the stone-block or sleeper should be placed in an angular direction with the length of rail or line of road, whereby a greater surface of stone would be placed in the directions most required, viz. lengthways and sideways. By this plan an 18-inch stone exposes a surface of 2 feet and more to the pressure.

Fig. 1 is a section of the rail as it rests in the chair, which, when the lower portion of the chair is let into the stone, will rest upon the stone also; the two small sections are for the purpose of fixing the centre of each rail to its chair. Fig. 2 is a vertical view, showing the angular position of the stone upon a smaller scale.

I am, Sir,
Yours respectfully,
P. WOODHOUSE.

Kilburn, May 27th, 1835.

MISCALCULATION OF THE RUSSIAN CALCULATING BOY.

Sir,—Well knowing that your Magazine is always open for the correction of errors, I trouble you with a notice of one which appears in your last volume (p. 191), in an article headed "Russian Calculating Boy," copied from the *Times* newspaper, and by that paper from the Memoirs of the Imperial University of Moscow. In this article it is stated that the boy was asked the following question:—"A certain number of poods of sugar were purchased for 500 rubles; if three poods more had been bought for the same sum, it would happen that each pood would have cost three rubles less. How many were purchased?" And he is said to have answered, that "20 was the number." Now, this number does not, as may easily be seen, answer the question, the real one being under a surd form. The equation to the problem is, when reduced, $x^2+3x=500$, whence

$$x=\frac{-3\pm\sqrt{2009}}{2}=20\cdot91,\ \&c.$$
$$\text{or } -23\cdot91,\ \&c.$$

His examiner is stated, in the article in question, to have been astonished at the *accuracy* of his answer! How such a statement should have found its way into the Memoirs of a learned University, I cannot imagine.

I am, Sir,
Your obedient servant,
A YOUNG MATHEMATICIAN.

Chippenham, Wilts, May 25, 1835.

BAINES'S HISTORY OF THE COTTON MANUFACTURE.

(Second Notice.)

The first notice which we gave of this work (vol. xxii. p. 424) was taken up with an examination of what the author himself regards (injudiciously, we think) as one of its best features, namely, the evidence which it contains, "never before published, and as decisive as it is novel," that the "real authorship" of the cylinder-spinning machine has been hitherto erroneously ascribed to Sir Richard Arkwright. We showed—unanswerably, we believe—that the inferences drawn by Mr. Baines from this new evidence in favour of John Wyatt, are wholly unwarranted—that if any person has a better claim than Arkwright to the honour of being the first inventor of the machine in question, it is Lewis Paul, and not John Wyatt—but that there is abundant reason to believe that Arkwright, though anticipated by Paul in the general idea of the thing, did, without any knowledge of what had been previously done, invent for himself the machine with which, and with the vast revolution it produced in the cotton manufacture, his name has been so long familiarly identified.

We now return to the book for the purpose of pointing out to the attention of our readers the many better things which it contains, and which, in spite of the injustice done by the author to the great hero of his subject, make it eminently worthy of universal perusal. Before passing, however, from the question of Arkwright's merits, it may not be amiss to select from the work grains of compen-

sation as it affords for the great wrong done by it to his memory in the matter of originality of invention.

The prodigious impulse given to the cotton manufacture by the improvements which Arkwright introduced, and the prominent part which he played in the direction of that impulse, are well depicted in the following passages—which present, at the same time, some new and curious traits in the character of this remarkable man:—

"When this admirable series of machines was made known, and by their means yarns were produced far superior in quality to any before spun in England, as well as lower in price, a mighty impulse was communicated to the cotton manufacture. Weavers could now obtain an unlimited quantity of yarn, at a reasonable price; manufacturers could use warps of cotton, which were much cheaper than the linen warps formerly used. Cotton fabrics could be sold lower than had been ever before known. The demand for them consequently increased, the shuttle flew with fresh energy, and the weavers earned immoderately high wages. Spinning mills were erected to supply the requisite quantity of yarn. The fame of Arkwright resounded throughout the land; and capitalists flocked to him to buy his patent machines or permission to use them. He sold to numbers of adventurers residing in the different counties of Derby, Leicester, Nottingham, Worcester, Stafford, York, Hertford, and Lancashire, many of his patent machines. Upon a moderate computation, the money expended in consequence of such grants (before 1782) amounted to at least 60,000*l.* Mr. Arkwright and his partners also expended in large buildings in Derbyshire and elsewhere, upwards of 30,000*l.*; 'and Mr. Arkwright also erected a very large and extensive building in Manchester, at the expense of upwards of 11,000*l.*' Thus a business was formed which already (he calculated) 'employed upwards of 5,000 persons, and a capital on the whole of not less than 200,000*l.*'"

"At the trial concerning the validity of the patent in 1785, only three years later, Mr. Bearcroft, the counsel, opposed to Mr. Arkwright, stated that 30,000 people were employed in the establishments *set up in defiance of the patent*,* and that near 300,000*l.* had been expended in the buildings and machinery of these establishments. If we add to this the mills where the patent machines were used, the capital and the population employed, will much exceed these amounts. The factory system in England takes its rise from this period."—P. 183-4.

"Arkwright was now rapidly making a large fortune, not merely by the sale of his patent machines and of licenses to use them, but much more by the profits of his several manufactories; for having no less enterprise than judgment and skill, and being supported by large capital and very able partners, he greatly extended his concerns, and managed them all with so much ability as to make them eminently prosperous. He offered the use of his patents by public advertisements; and gave many permission to use them on receiving a certain sum for each spindle. In several cases he took shares in the mills erected; and from these various sources he received a large annual tribute."—P. 187.

"Wealth flowed in upon him with a full stream from his skilfully-managed concerns. For several years he fixed the price of cotton-twist, all other spinners conforming to his prices."—P. 193.

"The most marked traits in the character of Arkwright, were his wonderful ardour, energy, and perseverance. He commonly laboured in his multifarious concerns from five o'clock in the morning till nine at night; and when considerably more than fifty years of age—feeling that the defects of his education placed him under great difficulty and inconvenience in conducting his correspondence, and in the general management of his business—he encroached upon his sleep, in order to gain an hour each day to learn English grammar, and another hour to improve his writing and orthography! He was impatient of whatever interfered with his favourite pursuits; and the fact is too strikingly characteristic not to be mentioned, that he separated from his wife not many years after their marriage, because she, convinced that he would starve his family by scheming, when he should have been shaving, broke some of his experimental models of machinery. Arkwright was a severe economist of time; and that he might not waste a moment, he generally travelled with four horses, and at a very rapid speed. His concerns in Derbyshire, Lancashire, and Scotland,* were

* This is not strictly correct. The trial here alluded to took place on the writ of *scire facias* to *repeat* the patent; but four years previously the patent had been found to be of no validity (on account of a defect in the specification) in the case of Arkwright *v.* Mordaunt, on which there were eight other suits for infringement dependent, which, in consequence of the verdict in favour of Mordaunt, were withdrawn. The establishments between 1782 and 1785 may with more propriety, therefore, be said to have been set up in consequence of the ascertained invalidity of the patent than "in *defiance*" of it.—*Rev.*

* On the subject of his Scottish speculations we have elsewhere the following note:—"The Lancashire spinners were Arkwright's great enemies. Owing partly, perhaps, to his humble origin and partly to the doubts whether he was the author of the inventions, 'he had no honour in his own coun-

so extensive and numerous, as to show at once his astonishing power of transacting business and his all-grasping spirit. In many of these he had partners, but he generally managed in such a way that whoever lost, he himself was a gainer. So unbounded was his confidence in the success of his machinery, and in the national wealth to be produced by it, that he would make light of discussions on taxation, and say, that *he* would pay the national debt! His speculative schemes were vast and daring; he contemplated entering into the most extensive mercantile transactions, and buying all the cotton in the world, in order to make an enormous profit by the monopoly; and from the extravagance of some of these designs, his judicious friends were of opinion that if he had lived to put them in practice, he might have overset the whole fabric of his prosperity.'—P. 195.

Among the subordinate improvements in the cotton machinery which originated with this master-spirit, but have, as well as the spinning-machine, been unfairly assigned to others, one of the most remarkable, both for its utility and for the pertinacity with which Arkwright's claim to the invention of it were disputed, was the addition of the crank and comb to the cylinder carding-engine (originally invented by Lewis Paul). The manner in which the wool was stripped off the finishing-cylinder in Paul's machine was by "needle-sticks." Mr. Peel (grandfather of the present Sir Robert) afterwards used hand-cards; then a roller was employed with tin plates upon it, like the floats of a water-wheel, which, revolving with a quick motion against the cylinder, scraped off the cotton from the card. This contrivance, however, injured both the cotton and the card; to remedy these defects, Arkwright substituted a plate of metal finely toothed at the edge, like a *comb*, which being worked by a *crank* in a perpendicular direction with slight but frequent strokes on the teeth of the card, stripped off the cotton in a continuous filmy fleece. The fleece as it came off was contracted and drawn through a funnel at a little distance in front of the cylinder, and was thus reduced into a roll or sliver, which, after passing betwixt two rollers, and being compressed into a firm, flat ribbon, fell into a deep can, where it coiled up in a continuous length till the can was filled. The person from whom Arkwright was stated to have pirated this happy contrivance was James Hargreaves. On the trial in 1775, Elizabeth, the widow of James Hargreaves, swore positively that "the crank was *first used* by her husband in partnership with James at Nottingham—that he worked by himself (while maturing the invention), and took great pains about the crank, and completed it so long ago that he began working with it thirteen or fourteen years before," that is, two or three years before the date of Arkwright's patent for the contrivance (1775). George Hargreaves, the son of James Hargreaves, swore, that in 1773, "his father had it in public use"—in his workshop, "where all the men worked." George Whittaker, a smith, stated, that he had made the crank which James Hargreaves first used, under instructions received from him; that he had afterwards made nearly twenty such machines; and that they were in very general use before 1775. And several cotton-spinners were brought forward who testified that they had used the crank and comb as early as 1773 and 1774. Justice Buller held it to be clearly made out, by this evidence, "that it was not Arkwright, but Hargreaves, who invented the crank and comb;" and so perhaps most persons would be disposed to infer. It is now, however, placed beyond all doubt, by the following confession made to an informant of Mr. Baines's by the son of the Mr. James, referred to in Mrs. Hargreaves' evidence as being the partner of her husband, that Arkwright was, after all, the real inventor. *In use* the crank and comb certainly were prior to the date of Arkwright's patent, and so far the witnesses swore correctly; but this turns out to have arisen from Arkwright's having himself used them for some time previous to taking out his patent, and being betrayed by one of his workmen, who communicated the manner of their construction to Hargreaves:—

"He (James Hargreaves) was *not* the inventor of the crank and comb. *We had a pattern chalked out upon a table by one of the Lancashire men in the employ of Mr. Ark-*

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try.' Being of an irritable temperament, he resented this treatment, and exerted himself to raise up a successful rivalry to Lancashire. He therefore favoured the Scottish spinners as much as possible, and formed a partnership with David Dale, Esq., of Lanark-mills; in allusion to which, and, probably, by way of retorting the unworthy taunts of his opponents, relative to his former occupation, he said, that 'he would find a *razor* in Scotland to *shave* Manchester!'"

wright; and *I* went to a frame-smith of the name of Young, to have one made. Of this Mr. Arkwright was continually complaining, and it occasioned some angry feelings between the parties."—P. 178.

A memorable lesson this to all intending patentees how they place themselves at the mercy of their workmen, or indeed of any body. The venerable Lord Eldon, when Chief Justice of the Common Pleas, once remarked:—"So many instances of piracy of inventions have come to my knowledge, that were I an inventor I would not disclose my invention to my own brother, until my right were secured by the Great Seal." And his Lordship said well; there is no other perfectly safe course to pursue.

The James Hargreaves who acted so unfairly by Arkwright, in the matter of the comb and crank, had, as our readers need scarcely be told, original merits of his own of a very high cast. He was the undoubted inventor of the spinning-jenny, which preceded, by a few years, Arkwright's cylinder spinning-machine, and almost rivalled it in utility. He was a poor, hard-working weaver, when he perfected this admirable invention; and is represented by all his biographers to have profited so little by it, that he ended his days in poverty and wretchedness. According to Arkwright's "Case," he "died in obscurity and great distress;" and to the *Edinburgh Review*, No. 91, he "died in the workhouse at Nottingham." We are glad, however, to learn from Mr. Baines, that there is no foundation for either statement. Although Hargreaves did not reap so rich a harvest as his fellow-inventor and contemporary, Arkwright (for which it may be reason good, that he was not, like Arkwright, a first-rate man of business as well as an inventor), he appears to have attained to a state of competence and ease by his mechanical talents, and to have left his family in circumstances far removed from destitution. The following is Mr. Baines's narrative:—

"I find from careful inquiry, that both Arkwright's statement and that of the *Edinburgh Review* are unfounded. Mr. John James, formerly a cotton-spinner (the son of Mr. James, who was the partner of Hargreaves), and also a grandson of Hargreaves, are still living at Nottingham; and a gentleman of that town, well-known for his extensive knowledge of local history and antiquities, has, at my request, obtained from them and from other authentic sources the following particulars, which may be fully relied upon:—James Hargreaves went to Nottingham in 1768, and worked for a while in the employment of Mr. Shipley, for whom he made some jennies secretly in his house. He was induced by the offers of Mr. Thomas James to enter into partnership with him; and the latter raised sufficient money on mortgage and loan to build a small mill in Hockley, where they spun yarn for the hosiers with the jenny. The patent was obtained in 1770. Finding that several of the Lancashire manufacturers were using the jenny, Hargreaves gave notice of actions against them; the manufacturers met, and sent a delegate to Nottingham, who offered Hargreaves 3,000*l.* for permission to use the machine; but he at first demanded 7,000*l.*, and at last stood out for 4,000*l.* The negotiation being broken off, the actions proceeded; but before they came to trial, Hargreaves' attorney (Mr. Evans) was informed that his client, before leaving Lancashire, had sold some jennies to obtain clothing for his children (of whom he had six or seven); and in consequence of this, which was true, the attorney gave up the actions in despair of obtaining a verdict. The spinning business was carried on by the partners with moderate success till the death of Mr. Hargreaves, which took place at his own house near the mill, in April, 1778. In his will he directed a guinea to be given to the vicar for preaching his funeral sermon. His widow received 400*l.* from Mr. James for her husband's spoil in the business, and having other property which her husband had accumulated, she left this sum to her children on her death."—P. 161-3.

After Paul, Hargreaves, and Arkwright, the next great improver of cotton-machinery was Samuel Crompton, who, by combining the principles of the spinning-jenny and water-frame (as the cylinder spinning-machine of Arkwright came to be commonly called, from its being moved by water-power), produced a third machine, much more efficient than either. At first this new invention was called the *Hall-in-the-Wood wheel*, from the place of Crompton's residence, and afterwards the *muslin-wheel*, from its producing yarn sufficiently fine for the manufacture of muslin; but it ultimately received the name of the *mule*, from its being (as it were) the offspring of the jenny and water-frame:—

"This excellent machine, which has superseded the jenny, and to a considerable extent the water-frame, and which has carried the cotton-manufacture to a perfection it could

not otherwise have attained, was invented by Samuel Crompton, a weaver of respectable character and moderate circumstances, living at Hall-in the-Wood, near Bolton. The date of the invention has been generally stated to be 1775, but Mr. Kennedy, who personally knew Crompton, and who has published an interesting memoir of his life, 'with a description of his machine called the mule, and of the subsequent improvement of the machine by others,' states that 'he was only twenty-one years of age when he commenced this undertaking, which took him five years to effect, at least, before he could bring his improvements to maturity.' As the inventor was born in 1753, he must therefore have begun to make his machine in 1774, and completed it in 1779. His own account is decisive,—he says in a letter to a friend:—'In regard to the mule, the date of its being first completed was in the year 1779; at the end of the following year, I was under the necessity of making it public, or destroying it, as it was not in my power to keep it, and work it; and to destroy it was too painful a task, having been four and a half years, at least, wherein every moment of time, and power of mind, as well as expense, which my other employment would permit, were devoted to this one end, the having good yarn to weave; so that, to destroy it, I could not.' Being of a retiring and unambitious disposition, he took out no patent; and only regretted that public curiosity would not allow him to 'enjoy his little invention to himself in his garret,' and to earn by his own manual labour, undisturbed, the fruits of his ingenuity and perseverance. The very superior quality of his yarn drew persons from all quarters to ascertain the means whereby he produced it. He stated to Mr. Bannatyne, that on the invention of his machine, 'he obtained 14*s*. per lb. for the spinning and preparation of No. 40 (*i. e.* yarn weighing 40 hanks to the pound), that a short time after he got 25*s*. per lb. for the spinning and preparation of No. 60; and that he had spun a small quantity of No. 80, to show that it was not impossible, as was supposed, to spin yarn of so fine a grist; and for the spinning and preparation of this yarn, he got 42*s*. per lb.' These prices were commanded by the unrivalled excellence of the yarn; and it affords a criterion to estimate the value of the machine, when it is found that the price of yarn, No. 100, is at present only from 2*s*. 3*d*. to 3*s*., including the cost of the raw material, which is 10*d*. or 1*s*.; this surprising reduction having been effected chiefly by the powers of the mule; and that whereas it was before supposed impossible to spin eighty hanks to the pound, as many as three hundred and fifty hanks to the pound have since been spun, each hank measuring 840 yards, and forming, together, a thread of a hundred and sixty-seven miles in length!"—P. 199-200.

The mule itself, however, was destined to undergo many important improvements. Crompton's first machine consisted of not more than 20 or 30 spindles, and his rollers were of wood. Henry Stones, an ingenious mechanic, of Horwich, substituted rollers of metal, and applied clock-work to move them; by which means the number of spindles was raised to 100. In 1790, Mr. William Kelly, of Lanark Mills, dismissed the clock-work, and employed water-power in its stead; by the introduction of which, Mr. Wright, a machine-maker, of Manchester, was shortly afterwards enabled to produce a double-mule, capable of working with no less than 400 spindles. Water-power gave way in its turn to the more potent agency of steam; and now there are mules at work in Manchester, and elsewhere, of the prodigious number of 1,100 spindles each, or 2,200 the pair —the whole being managed by one spinner! Nor did the course of improvement stop here. Even a single spinner to manage the 2,200 spindles' revolving-machine, was deemed one too many, and mules *that can act of themselves have* been introduced:—

"Mules have been constructed which do not require the manual aid of the spinner, the mechanism being so contrived as to roll the spindle carriage out and in at the proper speed, without a hand touching it; and the only manual labour employed in these machines, which are called *self-acting mules*, is that of the children who join the broken threads. The first machine of this nature was invented by the ingenious Mr. Strutt, F.R.S., of Derby, son of Mr. Jedediah Strutt, the partner of Arkwright; and the following mention is made of it in a memoir of that gentleman, written by his son, Mr. Edward Strutt, at present member for Derby. Mr. Strutt died on the 29th of December, 1830, and the memoir appeared shortly after in a periodical journal:—'Among his other inventions and improvements, we may mention a self-acting mule for the spinning of cotton, invented more than forty years ago' [therefore before 1790]; 'but we believe the inferior workmanship of that day prevented the success of an invention, which all the skill and improvement in the construction of machinery of the present day has barely accomplished.'"—P. 205.

But the self-acting mule which has

met with most success is that invented by Mr. Roberts, of the firm of Messrs. Sharp, Roberts, and Co., of Manchester. For all the finer qualities of yarn it is the only machine now employed:—

"By this machine, for which the first patent was taken out in 1825, and the second for a further improvement in 1830, a very close approach to perfection seems to be made. It produces a considerably greater quantity of yarn, of more uniform twist, and less liable to break, and it winds it on the cop more evenly and closely, so that the yarn is more desirable for the weaver. Roberts's self-acting mule is coming rapidly into use throughout the spinning district. In March, 1834, the patentees informed me that they had made 520 self-acting mules, containing upwards of 200.000 spindles, and that the number was likely to be more than doubled in the course of the year. One of the recommendations of this machine to the spinners is, that it renders them independent of the working spinners, whose combinations and stoppages of work have often been extremely annoying to the masters."—Pp. 207-8.

The genius of invention which had carried spinning by machinery to so high a degree of perfection was next directed to the operation of weaving, and did not rest till that also was rendered nearly as independent of human hands. But this branch of the subject, as also some others, we must reserve for a third and concluding notice of Mr. Baines's work.

NOTES AND NOTICES.

Scale of the Draught of Vessels.—We extract the following useful scale from the Report of Mr. Walker, C. E., on the Improvement of the Port of Edinburgh:—

A vessel of	200 tons	draws, according to the build,	from	12 to 13 feet
——	300	——	——	13 to 16
——	400	——	——	16 to 17½
——	500	——	——	17 to 18
——	600	——	——	18 to 19½
——	700	——	——	19 to 21

The Lights of Science and Thunders of the Vatican.—In the year 1818, Pius VII., a pontiff alike distinguished for his liberality and love of knowledge, procured a repeal of the edicts against Galileo and the Copernican system. He assembled the congregation; and the late Cardinal Toriozzi, assessor of the sacred office, proposed, that "they should wipe off this scandal from the Church." The repeal was carried with the dissentient voice of one Dominican only.—*Martin's Character of Lord Bacon, his Life and Works.*

The War-Cry of Innovation.—When Sir William Blackstone first began to deliver his law lectures before the University of Oxford, an attempt was made to cry him down as an innovator; and in various ways he was made to feel the influence of established opinions. In an introductory lecture, which, unfortunately, has not been published, he thus forcibly and eloquently retorted upon his opponents:—"In those scholastic days," said the learned commentator, "when the original and inquisitive mind of Roger Bacon was directed to the investigation of Nature's laws, the theological animus conspired against him, and he was accused of holding communion with evil spirits. Upon a particular occasion, when he intended to exhibit some curious experiments to a few select friends, the secret having got out, the whole town and all the colleges in the University were in an uproar. Priests, and fellows, and students, were seen flying about in every direction, with their gowns streaming behind them, crying out, 'No conjuror! no conjuror!' The cry of 'No conjuror' resounded from hall to hall, from cell to cell. At a later day, Galileo was condemned by men whose names are now remembered only as parts of the rubbish upon which the pedestal of his fame is raised. And in our times there are men who seek to raise the cry of 'No conjuror' against me. I tell you, you will soon find out that these good people are, at least, no conjurors themselves."—*Ibid.*

Chaucer, a Man of Science as well as Poet.—Chaucer wrote a species of astronomical work on the use of the astrolabe; the *first* treatise which we can prove to have been written in English on any part of science, and certainly the oldest of those which exist.—*British and Foreign Review, No. 1*; a new quarterly journal of excellent promise.

Great Britain, the great Fountain of Science.—It cannot but have struck every one who is at all acquainted with the subject, that there has been in this country either a singular number of coincidences, or a great aptitude for successful investigation of the *fundamenta* of different sciences. Bacon, Newton, Napier, Wallis, Brook Taylor, Bradley, Priestley, and others, are all connected with some one or more elementary points, either of speculation or observation, on which whole bodies of science, or prominent parts of bodies, are now constructed. How many of the brilliant results which have been brought amongst us from abroad can be traced back to some law or fact exported from England!—*Ibid.*

Invisible Muslins.—The late Rev. William Ward, a missionary at Serampore, informs us, that at Shantee-poorn and Dhaka, muslins are made which sell at a hundred rupees a piece. The ingenuity of the Hindoos in this branch of manufacture is wonderful. Persons with whom I have conversed on this subject, say that at two places in Bengal, Sonar-ga and Vikrum-poorn, muslins are made by a few families so exceedingly fine, that four months are required to weave one piece, which sells at 400 or 500 rupees. *When this muslin is laid on the grass, and the dew has fallen upon it, it is no longer discernible.*"

Magnanimity in Humble Life.—A short time since a fearful accident occurred by the breaking of machinery, which was raising some people to the mouth of a mine; they were all precipitated to the bottom with the exception of a youth and an old man; these caught by a rope which hung down into the mine. The first person to whom succour came, was the youth; he refused it, saying, 'Go to so-and-so (naming the man beneath him), *I* can hold on a little longer, *he* is quite exhausted.' Was

not this magnanimity—pure naked magnanimity—owing nothing to the trick or the trapping of station, catching nothing from the hope of reward or renown? Verily, amid all the gems that mines have yielded, this, to my imagination, is the brightest of any.—*Mrs. Grimstone, Monthly Rep., July.*

Retail Shops of London and Glasgow.—Messrs. James and William Campbell and Co.'s retail warehouses in Candleriggs street, Glasgow, contain 26,928 square feet of floor. In these premises the public are supplied with every kind of soft goods, and purchasers of a halfpenny lace or a pennyworth of thread are equally attended to as those who make larger purchases; 64 persons attend the customers. The amount of sales in 1831-2, was 812,207*l* 5*s*. 8*d*. Although Messrs. James Morrison and Co., Messrs. Leaf, Son, and Cole, and Mr. Wynn Ellis, of London, turn more money annually, there is no house in the King's dominions that serves so many customers as Messrs. Campbells', of Glasgow.—*Dr. Cleland's Notes on the Population Returns* (1831).

The Newcastle and Carlisle Railway, about which a Correspondent makes inquiry, is not yet wholly completed; but seventeen miles of it have been open for public traffic since the 9th of March last. In the last number of the *Sheffield Independent*, it is stated, that on the part now open, "the revenue is already at the rate of 13,000*l*. a-year," which, as "the expenditure on that portion of the work has been about 100,000*l*.," is more than equal to a profit of ten per cent.

Ship-building Reform.—We are happy to observe, the strong and wide-spreading impression which is making on the public mind by the praiseworthy exertions of Captain Ballingall of Kirkaldy, to put an end to the "ship-sinking system," so well described in the letter from a Correspondent, which we published the week before last. Hitherto Captain B. has found his chief approvers and supporters among the friends of humanity in his own country; but the circumstance we are about to mention, shows that on the Thames as well as Forth, his labours in the cause of maritime reform are beginning to be applauded and honoured as they deserve. The "Royal Sailing Society" of London, "King William IV. the Patron," have lately sent Captain B. a handsome silver medal, which bears on the obverse the style and title of the Society, and on the other the following inscription (within a wreath):—"To James Ballingall, Esq., of Kirkaldy, N.B., as a mark of approbation for his improved method of ship-building (of which models were exhibited), so as materially to lessen sea-risk and the loss of human life by shipwreck."

City Improvements.—The new street from the Mansion-house to London-bridge is now open for carriages as well as passengers, and the shops on both sides are rapidly approaching completion. The widening of Prince's-street has also been effected; and a complete breach has been made by pulling down the houses in the line, from the top of Prince's-street, in Lothbury, to the bottom of the City-road, at London-wall. Now that it can be seen in its whole extent, the line is much more tortuous than might have been expected.

Steam-Boat Explosions.—The *National Intelligencer*, adverting to the frequency and fatality of accidents of this description on the water of the United States, pithily observes:—"There is no certain remedy but to make the owners of the boats sweat for them. A penalty of 5,000 dollars for the death, and 1,000 dollars for the damage of every individual caused by the bursting of boilers, would soon put a stop to such occurrences; for they are all the result of negligence, incapacity, or culpable mismanagement."—We sincerely believe that in nine cases out of ten this is really the case.

The "Metropolis Pure Soft Spring Water Company."—The indignant rejection of this embryo Company's Bill by the House of Commons has been followed up by another heavy blow. It now appears that the much-talked-of well at Hampstead, on whose total *inexhaustibility* the projectors of the Company so entirely depended, as proving, in spite of all former experience, that the magazine of water in the London Basin could never, by any possibility, be diminished—has, on being pretty constantly pumped from, sunk very considerably, and has also produced the same effect on all the wells for a considerable distance! Surely *this* will settle the question as to unlimited supply! Such, at least, is, it may be conjectured, the opinion of one of the late Secretaries to the pure-water concern, who has turned his speculative genius in another direction, and now flourishes (still looking for treasure in the bowels of the earth) as Secretary to "The Candonga Mining Association."

A Humbug Revived.—Strange to relate, the South Australia colonisation project, which was apparently defunct, has begun again to exhibit signs of life. Pompous advertisements have just made their appearance, in which the peculiar advantages of the scheme are dwelt upon with as much easy assurance as if their futility had never been exposed; and settlers are invited to participate in them by paying *only* one pound per acre (twelve shillings was thought too little) for land which, all circumstances considered, cannot be worth one farthing! The Commissioners (who were Gazetted a few weeks ago) talk of sending out the Governor, with the first detachment of settlers, about September next; but in this they may chance to be disappointed, as their Act *forbids* the foundation of the colony until 35,000*l*. are paid down for allotments of land. The existence of this clause may account, in some measure, for the activity displayed in catching the first customers to this promising concern. Colonel Napier, who was sent for from Greece to be the first Governor, has thrown up his appointment, in consequence of the Colonial Secretary's refusal to allow him what he considers indispensable requisites—200 soldiers, *and an advance of cash!*

Cheap Travelling.—So excessively have the fares by steam-vessels been reduced, that it is calculated some of the north-country steamers convey passengers at less than one farthing per mile! It will be long ere steam-travelling by land exceed this!

Mr. Combe, on Messrs. Rennie's line of Railway from London to Brighton, in answer to Mr. Herapath, shall have a place in our next. He does us but justice in supposing that we have no other wish than that the real merits of each line should be placed fairly before the public.

D. E. No such patent has been taken out or, to our knowledge, applied for.

Communications received from Mr. Gilbert—Enort—X. Y. Z.—J. M.—Iver Maciver—G. G.—Mohammed al Moonghie—W. M. P.—Mr. Marr.

Our Publisher will give One Shilling and Sixpence for copies of the Supplement to Vol. IX.

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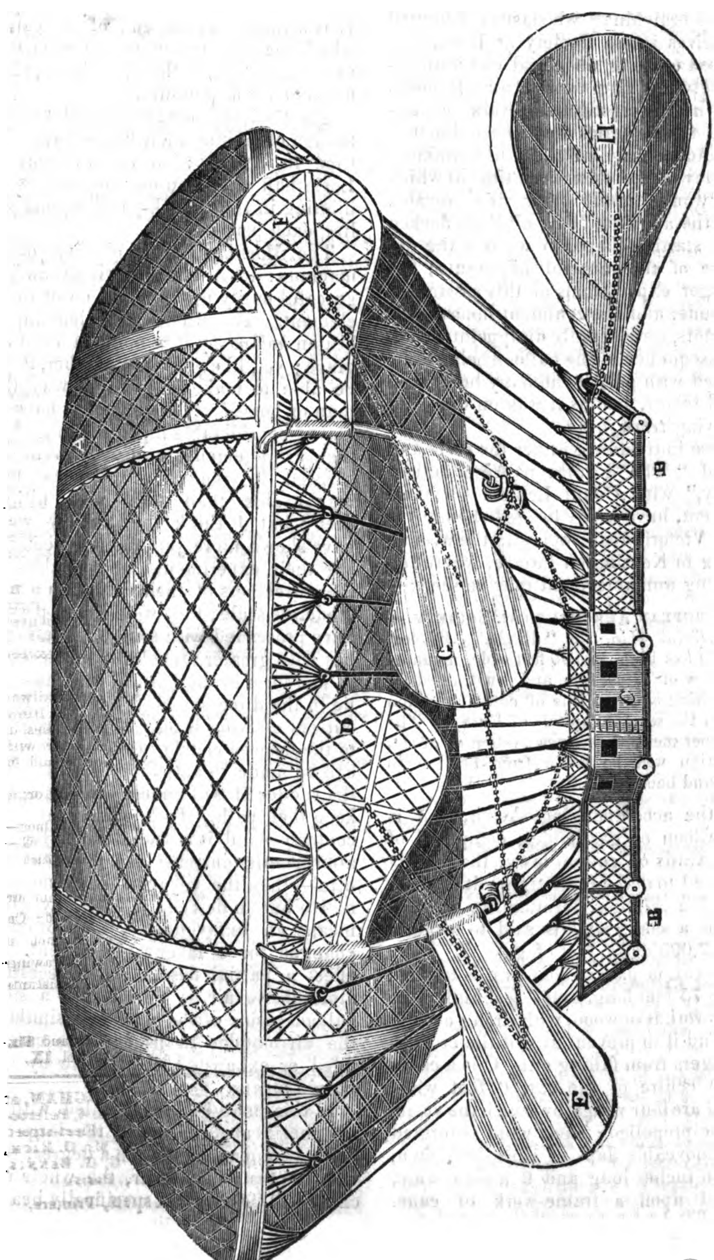
THE FIRST AËRIAL SHIP, THE "EAGLE."



THE FIRST AËRIAL SHIP, "THE EAGLE."

Sir,—Herewith I send you a rough pen-and-ink sketch of the "Eagle," which is at present the *Lion* of the day. This monster-machine is the production of some individuals who last year formed themselves into a Society at Paris, and proposed opening an aërial communication between that capital and London. After having instituted several experiments, these parties felt so confident of the practicability of their undertaking, that they actually fixed the time at which they would make their first voyage. Upon the appointed day, all Paris flocked to the starting-place, to witness the departure of the intrepid aëronauts; but the eager expectations of this assembled multitude, and the confident hopes of the projectors, were equally disappointed, for, in consequence of the balloon being overcharged with gas, it suddenly burst with a loud report, just as it was on the point of leaving *terra firma*.

These individuals, under the style and title of "The European Aëronautical Society," with Count Lennox for their President, have lately located themselves in the Victoria-road, opposite the avenue leading to Kensington Palace, where the following announcement may be seen:—

"EUROPEAN AËRONAUTICAL SOCIETY.—*First Aërial Ship*, the "Eagle," 160 feet long, 50 feet high, and 40 feet wide, mounted by a crew of 17 persons, and constructed for establishing a direct line of communication between the several capitals of Europe. The first experiment of this new system of aërial navigation will be made from London to Paris, and back again."

In the accompanying sketch, A A is the balloon or gas-holder, composed of 2,400 yards of cotton lawn, thoroughly varnished to make it air-tight; it is in the form of a cylinder, terminating at each end in a cone, and is said to contain about 7,000 cubic feet of gas.

The car, or packet-boat as it is termed, BB, is 75 feet long, and 7 feet high; the frame-work is of wood, with strong netting all round it to prevent any of the crew or passengers from falling out. C is a cabin in the centre of the car, 6 feet wide. DEFG are four wings, by which the vessel is to be propelled; each wing is formed of 80 moveable flaps of varnished lawn, 2 feet 6 inches long and 9 inches wide, strained upon a frame-work of cane. There is a strong netting on one side of the wings to support the flaps whilst striking the air and propelling the vessel. D and F show the net-work; E and G, the flaps. The mechanism for working the wings is placed inside of the cabin C. H is a rudder at the end of the car, by which the inventors expect to be enabled to steer the vessel through the trackless fields of air at pleasure.

The Society have announced their intention of making their first voyage some time in August; in the interim, this Leviathan of the upper regions is exhibiting in the "dock-yard" at one shilling each person.

The *Morning Herald* observes of this machine:—"A more unwieldy and ungraceful entity never moved on or in any element. The whale and elephant are beaten *hollow* by it in point of form and grace; yet, like one and the other, it may be able to make more rapid way than man or horse." The projectors have displayed considerable ingenuity in many of their arrangements, and may eventually succeed in rendering balloons more manageable than they have hitherto been; but I think the Society would have shown more judgment by continuing their experiments, and establishing the correctness of their theory on a more moderate scale; they would then possibly have proceeded with somewhat less *éclat*, but with greater probability of success.

The form of the balloon will cause it to lie in the direction of the wind. If the current of wind is only slightly contrary to the desired course, and the propellers can be made to act, there is little doubt the rudder H will enable the voyagers to keep their path. If the wind proves very contrary—and it is well known that the atmospheric currents are frequent and fitful—then the voyagers have no alternative but to descend a little, by which means an unfavourable, may often be changed for a favourable current. To effect a partial descent when necessary, atmospheric air is forced into a small balloon inside of the large one, similar to the air-bladder in fishes; this can be filled or exhausted at pleasure by very simple means.

If this small balloon is filled with atmospheric air, the gas in the large one will be compressed to such a degree, that, with the load in the car, the whole machine will be rendered specifically heavier

than the atmosphere, and descend accordingly. On reaching a more favourable current, the crew withdraw the air from the small balloon, and the gas expanding, restores a due proportion of the original buoyancy to the machine.

This method may answer the purpose, but it appears to me that there is great risk of bursting the balloon, by compressing the gas to such a degree as to effect an efficient reduction of the buoyancy. A much better plan was proposed by Mr. G. C. Atkinson, of Newcastle-on-Tyne (in your 10th volume), viz. to withdraw a sufficient quantity of gas from the balloon by condensing it into a suitable copper vessel, and restoring it again to the balloon as required.

With respect to the mode of propulsion adopted by the inventors of the "Eagle," I may just state, that I do not consider it by any means the best that could be employed.

I remember hearing a lecture on aërostation delivered by Mr. Tatum, some years since, in which he proposed to effect aërial navigation by means of two revolving vanes and a rudder. A very considerable velocity could be imparted to a pair of vanes, without so great a loss of power as must necessarily take place in using wings.

Balloons have for a long time past been mere toys, exhibited for the sake of gain; and, I confess, I am glad to see aërostation, as a science, is not entirely forgotten. There is, doubtless, but a very limited sphere of usefulness open to balloons; but, I believe, much more can be accomplished than many persons are at present prepared to admit. I may return to this subject again by-and-bye. In the mean time,

I remain, yours respectfully,

Wm. Baddeley.

London, July 6, 1835.

THE PROJECTED LINES OF RAILWAY FROM LONDON TO BRIGHTON.

Sir,—Having read in your Journal of the 20th ult. a letter from Mr. Herapath, in which he discusses the merits of the different lines of railway which have been proposed between London and Brighton, and being personally acquainted (which is more than Mr. Herapath pretends to be) with the engineering details of the subject, I beg to be allowed, through the same medium, to point out some very gross mistakes into which he has fallen (through *mis*information, of course). I feel convinced that *you* can have no other object than to place the eligibility of each line in its true light before the public; neither am I at liberty to suppose that Mr. Herapath is differently influenced: but I may be permitted to express my regret, that Mr. Herapath did not, for the sake of the character of your Journal (if not for his own sake) take more pains to make himself accurately acquainted with the actual characteristics of the competing lines, before taking upon himself to decide so oracularly (yet erroneously) between them. The ground plans and sections, required by law, have all been lodged at the offices of the different clerks of the peace, and could have been examined for (I believe) a very trifling fee. Had Mr. Herapath but consulted these documents (the only authentic ones on the subject), he would have been spared the necessity of going through that particular process which he affects to hold in such horror, namely, *groping the whole of his way in the dark*. He would have seen clearly, that the shortest or direct line between London and Brighton is such, that,

First. Instead of 7 miles of tunnelling out of the 47 miles of railway, there is not so much as $2\frac{1}{4}$ miles.

Second. That the longest tunnel, instead of being $2\frac{1}{4}$ miles in length, is only $\frac{3}{4}$ths of a mile; and that there is no such thing in any one of them as conflicting inclined planes.

Third. That the steepest inclination, instead of being at the rate of 1 in 97, is only 1 in 180.

Fourth. That the Balcombe Down summit is crossed at more than 100 feet less elevation above the tideway than he has stated.

And, fifth. That instead of having his nervous system endangered by crossing the River Mole, by an embankment raised some hundred feet in the air, the height of the embankment requisite will not exceed 15 feet.

In judging, moreover, of the skill with which this line has been laid down, it must always be remembered, that every other consideration was made subordinate to that of *distance*. The question is not whether it is the most level line—and the freest from locomotive difficulties—that can

anywhere be found between London and Brighton; but whether, taking the shortest course from point to point, any better could have been selected? When Messrs. G. and J. Rennie surveyed this line in 1825, by direction of a Committee of the "Surrey, Sussex, Hants, Wilts, and Somerset Railway Company," they made a survey at the same time of a longer line, which should take in Epsom, Dorking, Horsham, and Shoreham; leaving it to the Committee to determine whether the advantages to be gained by taking that circuitous course were sufficient to make up for the difference in point of distance. This last line was surveyed for the Messrs. Rennie by Mr. Vignoles, and is the one now advocated by Mr. Cundy.* The whole project, however, was soon after abandoned for want of funds, the Committee coming to no decision as to which of the lines it was the most advisable to adopt. In 1833, the subject was again taken up, when both lines were submitted to the Committee by the Messrs. Rennie, and their respective advantages and disadvantages fully explained. The Committee then decided upon adopting the shortest and most direct line; on which, the Parliamentary surveys, &c., of that line were proceeded with, and every preparation made for applying to Parliament. The Committee, however, not having been unanimous in their preference of this line, differences and discussions arose, which led to the intended application to Parliament being deferred, and to further inquiries being instituted, which are at this moment still in progress. As the question of the best line remains, therefore, yet to be decided, it may not be out of place to examine here a little more minutely the merits of the two lines to which I have here alluded.

1. The shortest or direct line proceeds by Croydon, Merstham, Red Hill, Tilgate, Cuckfield, St. John's Common, and Clayton Hill, to Brighton, being a total distance of 47 miles from Kennington Common. The steepest inclinations are 1 in 180, or 29 feet 4 inches to the mile, but this only on approaching the respective summits for about two miles each way. The other inclinations vary down to a perfect level. There are four tunnels. The first at Merstham is 700 yards long; the second at Tilgate or Balcombe, 700 yards; the third at Cuckfield, 1,330 yards; and the fourth at Clayton Hill, 1,200 yards; making in all rather less than 2¼ miles, which is shorter than the united lengths of two tunnels on the London and Birmingham, and little more than the length of a single one on the Grand Western Railway now before Parliament. The whole of the tunnels, as well as the open cuttings, are through chalk and sandstone. The highest embankments are 65 feet, but this in no instance for more than 200 yards in length, and only in one or two places. The land, comparatively speaking, is of little value. No parks or pleasure-grounds are interfered with, and the line is well adapted (better, indeed, than any other that could be chosen,) for branching eastward to Lewes, Newhaven, Hastings, and Tunbridge-Wells, &c. &c. westward to Shoreham, Worthing, and Portsmouth.

2. The long line proceeds by Merton, Epsom, Leatherhead, Boxhill, Dorking, Horsham, Shoreham, to Brighton, being a distance of about 58 miles, or nearly 11½ more than the other. The steepest inclinations are 1 in 200 for at least 10 miles, and the others vary to a level as in the direct line. The cuttings are mostly through clay, the worst of materials; and to avoid tunnels, particularly near Horsham, it will be necessary to cut 90 to 100 feet deep for nearly three-fourths of a mile.

The quantity of cuttings and embankments are about equal upon both lines. The land, however, upon the long line, consists of scarcely any thing else but parks and pleasure-grounds; it is altogether very expensive; and the proprietors, with very few exceptions, are decidedly hostile. The entry into Brighton, too, is from one end only, instead of in the centre, as in the case of the direct or short line, so that a person going to Kemp Town after leaving the railway, would lose nearly as much time as one-fourth of the journey from London. Again, this line may be shortened about two miles, but to do so there would have to be a tunnel of at least half a mile in length near Dorking, besides some very heavy additional cutting, which would materially increase the expense.

Upon the whole, therefore, the preponderance of advantage is decidedly on

* What is known at the present time as *Mr. Vignoles' line* is a third line, lately surveyed by that gentleman, which goes by Herne-hill, Manning's-heath, Bramber, and Shoreham.—ED. M. M.

the side of the *direct line*, except in the matter of tunnels. Considering, however, that there are to be no fewer than eleven tunnels on the London and Birmingham Railway, some nearly 1½ miles long, and several upon the Grand Western now before Parliament, one of which is 1¾ miles long, the objection made on this ground to the Brighton line, can hardly be considered as of much weight.

I would just add, with regard to Mr. Cundy's line, a copy of which Mr. Herapath states he has seen and founds his arguments upon, that I am credibly informed, Mr. Robert Stephenson, when recently reporting upon it, used words to the following effect:—"The levels and survey are so incorrect, that it is impossible to form any opinion upon it."

Having now, I trust, placed the subject clearly before your leaders, it only remains that I should apologize for not replying to Mr. Herapath's letter earlier, owing to pressure of business, and to you, Mr. Editor, for having trespassed so much upon your columns, and

I remain, Sir,
Your obedient servant,
JAMES COMBE, Civil Engineer.

35, Nelson-square, 8th July, 1835.

WELCH COAL.

Sir,—I observe a notice in your Magazine for June, respecting Welch coal for steamers. The advantages of this article are at present by no means fully appreciated. There are perhaps twenty veins or seams of coal in Wales, and the qualities differ widely. We have such as compares with Scotch and Newcastle in all respects, for *heat*, *economy*, and *smoke*. These find their way into the market, and, from their analogy to others, lose their Welch name. We have, besides these, veins or seams which produce *very little smoke*, and yet have much flame and heat; these are commonly known in the market as Welch coal by the names of Llangennech, or Nevill's Llangennech, Graigola, and Bryndewy. It probably may be attributed to the demand for and prices of these at the pits, that the striking advantage of yielding little smoke has in so small a degree attracted the public attention. I have frequently been astonished, in days of *reform* like the present, when the intellect is so much rescued from the clouds of ignorance which have aforetime encompassed it, that the multitudes inhabiting large cities and towns suffer themselves still to be smothered with blacks or smuts, from the numerous engine and manufactory chimneys, pouring volumes of black smoke on all around them. How is it, that none of our patriotic agitators think of inquiring, why they continue to consume coal yielding so much smoke, when, at but little more expense, they may obtain a species of fuel which is at once economical and free from the nuisance? In proof of the saving to be obtained from the use of Welch coal, I subjoin a certificate, of which I hold a copy, and wish you would invite the attention of your readers to the subject:—

"An experiment was made on board the Ionian Government steam-vessel, the *Eptaniros*, between coals received from Glasgow and those from Swansea known by the name of Bryndewy coals; and the result was, that the same weight of the former were consumed in three hours, while the latter lasted four hours—being a difference of 20 per cent. in favour of the latter, each under equal circumstances.

(Signed) "JOSEPH THOMAS,
"Commander of the *Eptaniros*.

"Swansea, May 7, 1834."

I am, Sir, yours, &c.
A. B. C.

Notwithstanding the *Welch interest* apparent in the letter of our correspondent, we have no hesitation in adding our opinion, that the Welch coal fully deserves all that he has said in its commendation. Its properties were very fully inquired into in the course of the late Parliamentary Inquiry into Steam Navigation to India, and much valuable evidence was elicited in its favour. We subjoin an extract or two:—

T. L. Peacock, Esq., Assistant Examiner in the East India House, examined.

"How would coal, if required, be supplied for the Euphrates?—If coals were sent direct from England to Bussorah in sailing vessels, I think it would be cheaper than by sending through the Mediterranean; the best way would be to send it out as the Court did to Bombay last year: 500 tons of Llangennech coal were sent in a vessel chartered for the purpose direct from the port of Llanelly; the price of the coal was 10*s*. a ton, delivered hand-picked on board, and the freight was 25*s*., which was to clear all charges except the delivery at Bombay. Coal had never been sent before for less than 60*s*. per ton, taking all charges together; this coal is be-

sides better than any that had been sent before. Captain Wilson says, the same consumption that before carried him six days and a half, carried him with this coal nine days. Some of the commanders of the Mediterranean packets have represented the strength of the Llangennech coal to be as 16 to 11 of the Newcastle. It was upon this report. and for a number of other reasons, the Company tried the experiment of sending it to India, and it appears to have answered extremely well.

"Is there any large supply of that coal? —There is a very great supply; there is a large tract of country, called the Great Coal Basin of South Wales; it contains a great quantity of coal of different kinds, and of this sort a considerable portion. There is another Company which has a railroad; their coal does not appear to be so powerful as this. The Llangennech Company said, when they had got all their works completed, they thought they could supply any demand that might be made upon them; at all events, they would be able to supply all the demands of the East India Company.

"Have you had any experience of the Forest of Dean coal?—No; none at all.

"Is the Llangennech coal chosen as peculiarly adapted for steam?—Yes; it was recommended by the commanders of the Mediterranean packets. The Court had a letter from the Bombay Government stating that a great deal of the coal which had been sent for steam purposes had taken fire in the storehouses, that it had done a great deal of injury, and was unfit for steam furnaces, so much so that they were quite certain no private individual would have thought of purchasing it. On the receipt of this letter inquiries were instituted in all quarters. I wrote to Messrs. Maudslay and others, requesting their opinion of the different kinds of coal used for steam furnaces, and especially asking their opinion as to this Llangennech coal, of which I had heard before, and of the coal which had taken fire. A young engineer, who went out with the last iron boats, went round to several of the great breweries and engineers, and got their opinions about all sorts of coal. The majority of opinions were that the Llangennech coal was the best for steam purposes. There are others very good, but opinions appeared to be unanimous in favour of that; I have since heard one opinion, that the Graigola coal, a Welch coal from the same district, is better; but the majority of opinions are that the Llangennech coal is the best. Mr. William Morgan told me that he preferred the Graigola coal to any other Welch coal.

* * * * * * *

"How would you guard against the accident of the spontaneous ignition of coal?—By using only the best coals containing the smallest proportion of sulphur. The Court had brought to its knowledge several instances of spontaneous ignition of coal; three at Bombay, one in a vessel carrying out coals for the Hugh Lindsay, two in private ships at Calcutta, the London and the Roxburgh Castle, and one at St. Helena in the public store-yard, where it was said to have happened several times previously, but it had not been before reported. I inquired of the owners of the Roxburgh Castle what kind of coal they had on board; they told me the Seremerstone Engine coal; I procured a specimen, and found it was full of iron pyrites.

"What coal do you recommend as the best?—The Llangennech coal has no sulphur in it; it is always sold in large pieces; it was put, hand-picked, on board the vessel which took it to Bombay. It is not liable to spontaneous ignition: there are three things necessary to spontaneous ignition; first, that there should be a large quantity of sulphur; next, that the coal should be in a state of powder; and next, that it should get wet. It generates a sort of gas, which, the moment it is exposed to the air, takes fire. When they opened the hatches of the London, in Calcutta, the flames burst out; they wondered that the fire had not occurred before. The captain told me he was certain if they had been at sea 24 hours longer they would all have been lost, and he brought me some specimens of the coal as they took it out, half burnt. They half scuttled the vessel; they sunk her in shallow water to extinguish the fire.

"Has not this danger been always known? —It has always been known, but it has been much more frequently observed since the alteration of the coal laws; when they were bought by measure the coals used to be more screened, but now they throw in the dust to make up weight."

DISTILLATION OF SALT WATER.

The subject of the distillation and purification of salt water having been frequently discussed in the Mechanics' Magazine, a correspondent has favoured us with a copy of a report made by Mr. Secretary (afterwards President) Jefferson to the American Congress, "on a claim for a reward for a discovery, alleged to have been made on that subject." It contains some very interesting historical and scientific particulars respecting it, which, we believe, are not generally known; and shows, that at the date of the report, as much was known upon the subject as at the present day, and that, save a knowledge gained from

experience—in one instance, rather costly —of a few plans that will not answer, we are no nearer the attainment of the desired object than we were half a century ago.

Experiments by T. Jefferson, Esq., Secretary to the United States of America, on the Distillation of Salt Water.

(Being a Report by him to the American Congress on a claim for a reward for a discovery, alleged to have been made on that subject.)

The petitioner sets forth, that, by various experiments, with considerable labour and expense, he has discovered a method of converting salt water into fresh, in the proportion of eight pints out of ten, by a process so simple, that it may be performed on board of vessels at sea by the common iron cabouse, with small alterations, by the same fire, and in the same time, which is used for cooking the ship's provisions; and offers to convey to the government of the United States, a faithful account of his art, or secret, to be used by or within the United States, on their giving to him a reward suitable to the importance of the discovery, and, in the opinion of government, adequate to his expenses, and the time he has devoted to the bringing it into effect.

In order to ascertain the merit of the petitioner's discovery, it becomes necessary to examine the advances already made in the art of converting salt water into fresh.

Lord Bacon, to whom the world is indebted for the first germs of so many branches of science, had observed, that, with a heat sufficient for distillation, salt will not rise in vapour, and that salt water distilled is fresh. And it would seem that all mankind might have observed, that the earth is supplied with fresh water chiefly by exhalation from the sea, which is, in fact, an insensible distillation effected by the heat of the sun. Yet this, though the most obvious, was not the first idea in the essays for converting salt water into fresh. Filtration was tried in vain, and congelations could be resorted to only in the coldest regions and seasons. In all the earlier trials by distillation, some mixture was thought necessary to aid the operation by a partial precipitation of the salt, and other foreign matters contained in sea water. Of this kind were the methods of Sir Richard Hawkins, in the 16th century; of Glauber, Hauton, and Lister, in the 17th; and of Hales, Appleby, Butler, Chapman, Hoffman, and Dove, in the 18th: nor was there any thing in these methods worth noting on the present occasion, except the very simple still contrived extempore by Captain Chapman, and made from such materials as are to be found on board every ship, great or small. This was a common pot with a wooden lid of the usual form, in the centre of which a great hole was bored to receive, perpendicularly, a short wooden tube, made with an inch and half auger; which perpendicular tube received at its top, and at an acute angle, another tube of wood also, which descended till it joined a third, of pewter, made by rolling up a dish, and passing it obliquely through a cask of cold water. With this simple machine he obtained two quarts of fresh water an hour, and observed, that the expense of fuel would be very trifling, if the still was contrived to stand on the fire along with the ship's boiler.

In 1762, Dr. Lind, proposing to make experiments of several different mixtures, first distilled rain water, which he supposed would be the purest, and then sea water, without any mixture, which he expected would be the least pure, in order to arrange between these two supposed extremes, the degree of merit of the several ingredients he meant to try. "To his great surprise," as he confesses, "the sea water distilled without any mixture was as pure as the rain water." He pursued the discovery, and established the fact, that a pure and potable fresh water may be obtained from salt water by simple distillation, without the aid of any mixture for fining or precipitating its foreign contents. In 1767, he proposed an extempore still, which, in fact, was Chapman's, only substituting a gun-barrel instead of Chapman's pewter tube, and the hand-pump of the ship to be cut in two, obliquely, and joined again at an acute angle, instead of Chapman's wooden tubes bored express; or instead of the wooden lid and upright tube, he proposed a tea kettle, (without its lid or handle,) to be turned bottom upwards, over the mouth of the pot, by way of still head, and a wooden tube leading from the spout to a gun-barrel passing through a cask of water, the whole luted with equal parts of chalk and meal moistened with salt water.

With this apparatus, of a pot, tea-kettle, and gun-barrel, the Dolphin, a twenty-gun ship, in her voyage round the world in 1768, from fifty-six gallons of sea water, and with nine pounds of wood, and sixty-nine pounds of pit coal, made forty-two gallons of good fresh water at the rate of eight gallons an hour. The Dorsetshire, in her passage from Gibraltar to Mahon, in 1769, made nineteen quarts of pure water in four hours with ten pounds of wood. And the Slambal, in 1773, between Bombay and Bengal, with a hand pump, gun-barrel, and a pot, of six gallons of sea water made ten quarts of fresh water in three hours.

In 1771, Dr. Irvine putting together Lind's idea of distilling without a mixture, Chapman's still, and Dr. Franklin's method of cooling by evaporation, obtained a premium

of 5,000l. from the British Parliament. He wet his tube constantly with a mop instead of passing it through a cask of water: he enlarged its bore also, in order to give a freer passage to the vapour, and thereby increase its quantity by lessening the resistance or pressure on the evaporating surface: this last improvement was his own, and it doubtless contributed to the success of his models; and we may suppose the enlargement of the tube to be useful to that point at which the central parts of the vapour, passing through it, would begin to escape condensation. Lord Mulgrave used his method in his voyage towards the North Pole, 1773, making from thirty-four to forty gallons of fresh water a day, without any great addition of fuel, as he says.

M. de Bougainville in his voyage round the world, used very successfully a still which had been contrived in 1763, by Poyssonier, so as to guard against the water being thrown over from the boiler into the pipe, by the agitation of the ship. In this, one singularity was, that the furnace or fire-box was in the middle of the boiler, so that the water surrounded it in contact. This still, however, was expensive, and occupied much room.

Such were the advances already made in the art of obtaining fresh from salt water, when Mr. Isaacks, the petitioner, suggested his discovery.

As the merit of this could be ascertained by experiment only, the Secretary of State asked the favour of Mr. Rittenhouse, president of the American Philosophical Society, of Dr. Wistar, Professor of Chemistry in the College of Philadelphia, and Dr. Hutchinson, Professor of Chemistry in the University of Pennsylvania, to be present at the experiments. Mr. Isaacks fixed the pot of a small iron cabouse, with a tin cap, and straight tube of tin, passing obliquely through a cask of cold water; he made use of a mixture, the composition of which he did not explain, and from twenty-four pints of sea water, taken up about three miles out of the Capes of Delaware at flood tide, he distilled twenty-two pints of fresh water in four hours, with twenty pounds of seasoned pine, which was a little wetted by having lain in the rain.

In a second experiment on the 21st of March, performed in a furnace and five gallon still at the college, from thirty-two pints of sea water he drew thirty-one pints of fresh water in seven hours, twenty-four minutes, with fifty-one pounds of hickory, which had been cut about six months. In order to decide whether Mr. Isaacks' mixture contributed in any and what degree to the success of the operation, it was thought proper to repeat his experiment under the same circumstances exactly, except the omission of the mixture. Accordingly, on the next day, the same quantity of sea water was put into the same still, the same furnace was used, and fuel from the same parcel. It yielded, as his had done, thirty-one pints of fresh water in eleven minutes more of time, and with ten pounds less of wood.

On the 24th of March, Mr. Isaacks performed a third experiment. For this, a common iron pot of 3½ gallons was fixed in brick work, and the flue from the hearth wound once round the pot spirally, and then passed off up a chimney. The cape was of tin, and a straight tin tube of about two inches diameter, passing obliquely through a barrel of water, served instead of a worm. From sixteen pints of sea water he drew off fifteen pints of fresh water, in two hours fifty-five minutes, with three pounds of dry hickory and eight pounds of seasoned pine. This experiment was also repeated the next day, with the same apparatus and fuel, from the same parcel, but without the mixture. Sixteen pints of sea water yielded, in like manner, fifteen pints of fresh, in one minute more time, and with half a pound less of wood. On the whole, it was evident that Mr. Isaacks' mixture produced no advantage either in the process or result of the distillation.

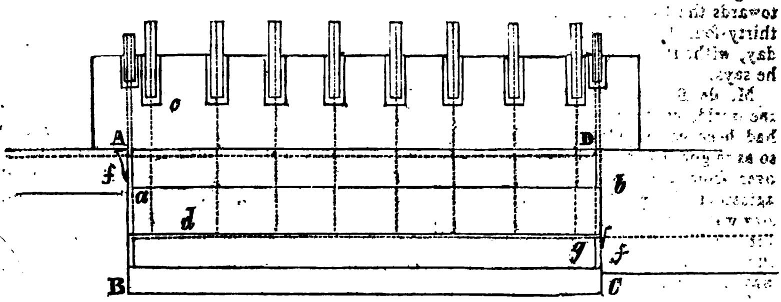
The distilled water, in all these instances, was found on experiment to be as pure as the best pump-water of the city. Its taste, indeed, was not as agreeable, but it was not such as to produce any disgust. In fact, we drink, in common life, in many places, and under many circumstances, and almost always at sea, a worst tasted, and, probably, a less wholesome water.

The obtaining fresh from salt water, for ages, was considered as an important desideratum for the use of navigation. The process for doing this by simple distillation is so efficacious, the erecting an extempore still with such utensils as are found on board of every ship, is so practicable, as to authorise the assertion, that this desideratum is satisfied to a very useful degree. But though this has been done for upwards of thirty years, though its reality has been established by the actual experience of several vessels which have had recourse to it, yet neither the fact nor the process is known to the mass of seamen, to whom it would be most useful, and for whom it was principally wanted. The Secretary of State is therefore of opinion, that since the subject has now been brought under observation, it should be made the occasion of disseminating its knowledge generally and effectually among the seafaring citizens of the United States. The following is one of the many methods which might be proposed for doing this. Let the clearance for every vessel sailing from the ports of the United States be printed on a paper, on the

back whereof shall be a printed account of the essays which have been made for obtaining fresh from salt water, mentioning shortly those which have been unsuccessful, and more fully those which have succeeded; describing the methods which have been found to answer for constructing extempore stills of such implements as are generally on board of every vessel; with a recommendation in all cases, where they shall have occasion to resort to this expedient for obtaining water, to publish the result of their trial in some gazette on their return to the United States; or to communicate it for publication to the office of the Secretary of State, in order that others may, by their success, be encouraged to make similar trials, and be benefitted by any improvements or new ideas which may occur to them in practice.

TH. JEFFERSON.

WOODHOUSE'S "SUBSTITUTE FOR CANAL LOCKS."—(See p. 31.)



Sir,—Mr. Woodhouse, in the construction of this machine, availed himself of the important principle in hydrostatics, that a vessel in water, or any other fluid, displaces a mass equal to itself in weight; and that in the case of a suspended body, whatever its weight or magnitude, if counterpoised by an equal weight connected with it by a chain, &c. over a pulley, a very small additional power, if applied on one side, will be sufficient to raise or depress the other.

The machine, adapted to a twelve feet lift, was erected some years since at Tardebigg in Worcestershire, and was in very successful operation there for several weeks. It consisted of a vessel called a conductor, large enough to hold a narrow boat, and to allow her to swim in and out freely, built with three-inch deal planking, and caulked like a boat, with screw-pins through the gunnel and bottom, to save room; this vessel, whith the water in it, weighed 64 tons, and was counterpoised by 8 weights of 8 tons each. A brick wall of eight feet thick, high enough to allow for the 12 feet lift, was built close by the side of the lock which contained the conductor, and eight interstices were left in it of 6 or 7 feet in depth, sufficient to allow eight cast-iron wheels, each of 36 feet circumference, to revolve freely there in vertical planes, the pivots of these wheels working in sockets bedded in cast-iron on the top of the wall. The eight counterpoise weights were connected with the conductor by means of chains and iron rods, going round the peripheries of the wheel. These weights were composed of solid masonry, and were kept, on ascending, in the same planes by guide-posts, one on each side; and, in descending, they passed into well-holes, similar to the paddle-pits at common locks.

Suppose A B C D a longitudinal section of the lock in which the conductor moves; the levels of water in the canal at the summit and below the lift being denoted by the horizontal dotted lines; the conductor is shown in the upper level at A, D, a b, and similarly at the lower level; the wall with the eight wheels, &c. being also shown in section; the lines c d, &c. are the chains round the wheels, fastened to the conductor on this side, and to the weights on the other side of the wall. The communication between the conductor and the two levels of the canal is made by a sluice at each end of the lock to draw up like a paddle or flood-gate: there is also a similar sluice at each end of the conductor. In each of the canal sluices there is a small paddle, as e and f, to be

drawn up by hand:—if the conductor is at the lower level, the paddle *e* is drawn up, and the water enters the space *e g* between the two sluices, and sets them floating, so that they can both be drawn up with ease, by a small force as applied to a windlass to raise them, and then a boat may enter the conductor; and when it does this, it displaces, or sends out of that vessel, its own weight of water. The sluices at *g* and *e* must then be dropped, and the conductor being now on a balance with the weights behind the wall, the strength of two men will be found amply sufficient to raise it to the upper level, which being done, the small paddle *f* is drawn up to set the two upper sluices floating in the same manner as described for the two lower ones; the upper sluices are then drawn up as before, and the boat may be passed out. The loss of water with this arrangement is only that contained between either pair of the sluices.

The time of getting a boat up or down with this lift was about five minutes, and the motion of the conductor, when in order, is described as having been so perfect, that the surface of water in it was often unruffled during the whole ascent and descent. There are several particulars wanting to render the above description complete, but I have not been able to obtain them at present, and can only add, that the machine having been injured by lightning soon after it was put up, was not repaired afterwards; indeed, it has now been quite out of use for several years, and I cannot learn that the principle has been elsewhere applied; it being found, I suppose, too complex for general use, and that the expense of its construction and repair would be such, in most cases, as to outweigh the disadvantage of an occasional scarcity of water. Whatever may have been the cause of its rejection, however, much credit is unquestionably due to its originator for his ingenuity, as displayed in this invention, and for his perseverance afterwards in bringing it so nearly to a successful practical issue.

I am, Sir, yours, &c.

Jos. Gilbert.

Welford, May 18, 1835.

P. S.—Since writing the above, I have made further inquiries to ascertain the mode of fixing the chains to the conductor, and the precise method adopted in applying the power of two men to move the conductor and sluices; but have been unable to obtain any satisfac-factory information on these points. I think it probable, however, that the conductor was suspended by the chains like a scale, and that it was put in motion, together with the sluices, by means of racks and a series of pinions on the same iron axis, with a windlass at each end. The loss of water for each boat amounted to a few gallons only; and the estimated cost of the machine somewhat exceeded 1,000*l*.—J. G.

THE SMOKE NUISANCE.

Sir,—Having recently passed through the manufacturing districts, the *horrible nuisance* from smoke was forced upon my consideration; and to get rid of it appeared more than ever a desideratum. I have thought,—but whether it can be accomplished or not, perhaps repeated experiments alone can prove—that it is possible to pump out the air, soot, and smoke, from a furnace, and convey it into a drain or sewer, when the soot and smoke may be separated from the air and mixed with water, and thus converted into manure. Your correspondent, Mr. Alfred T. J. Martin, in his Hydraulic Blast-Wheel, has furnished me with a hint, and I therefore ask him, whether his machine could not be employed as advantageously in drawing air through a furnace as in blowing air into one?

We all know that in a room where there is a fire in cold weather, the cold air rushes through the key-hole of the door and every crevice with violence; and, consequently, it is thought, if the fuel chamber of a furnace were exhausted of its air, fresh air would rush through an aperture, or many apertures, if found more desirable in various positions, with as great velocity as can be forced in by bellows or other means. It is supposed, that it can only be ascertained by experiment:—1. What power will be required to put the machine in motion? And, 2. What quantity of water and length of drain will be necessary to wash the smoke and soot out of the air from a furnace consuming a given quantity of fuel?

It will be perceived, that if machines of this kind could be made available for furnaces, they would also be applicable to private dwellings and cities, and I

need not tell you that I should be glad to see every tall boy and chimney-pot levelled with the dust. This is a fine field for our Architectural Society and Associations, for no city or building can be made truly ornamental if they are to be surmounted or surrounded by such ridiculous contrivances. How any person, calling himself an *architect*, can honourably encourage the erection of such things, I am at a loss to conceive. Will any one be admitted as a member of either of the Associations for the improvement of architecture who directs the erection of cowls and tall-boys?

I am, Sir,
Your obedient servant,
JOSEPH JOPLING.

31, Somerset-street, 11th July, 1834.

SELF-ACTING MACHINERY.

Sir,—You very kindly inserted in your useful magazine my letter on this subject about eighteen months ago—will you allow me to trespass a little further on your kindness, by requesting an early place for the following?

The possibility of making a perpetual motion, or machinery to generate the power it works with, is affected to be treated as an "idle chimera" equally vain and opposed to the well-established laws of nature and mechanics; but in spite of this, perpetual-motion-seekers are more numerous than any superficial observer may imagine. Having already made an avowal of my confidence of the practicability of making self-acting machinery, I have had occasion to hear much said on the subject:—many, with whom I have conversed, after quoting what this or that learned gentleman has said on the impossibility of the thing, have taken "heart of grace" from hearing me still profess my confidence in my plans, and at length acknowledged, that they (themselves) turned their attention to it at one time, and believed they could lay down plans by which self-acting machinery could be made to do such and such particular work! One person, after "beating about the bush" as above, alledged that he could "make a *wheel* which would be able to turn a *grunstane!*" Thus you see, sir, perpetual-motion-seekers abound; and though they pretend to laugh at the idea, yet are they secretly labouring to catch—what is it Bishop Wilkins calls it?—the "chaste wanton."

I believe most of the engineers of the present day have been perpetual-motion-seekers; but disappointed by repeated failures, have given up the thing as a false deluding chimera unworthy of their study:—though I have heard it said (whether true or false I know not—neither is there any offence meant) that Mr. Hancock, of steam-carriage celebrity, remarked once, that "if he had an hundred *sons*, he would like them all to study perpetual motion; for if it had no other beneficial effect, it would make them familiar with the various modes of connecting the working parts of machinery."

But I am so engrossed with the spirit of comment, that I had almost forgot to say a few words for myself, and to explain my reasons for sending this paper. Since writing my last notice on this subject, I have become more and more convinced of the correctness of my views, and have so far improved on them, that I am enabled to aver that I can give sufficient directions for making self-acting machinery, to work either by condensation or rarefaction of air—by the gravitating force of water—by mercury—by the self-adjusting gravity of dead weights—and by the pressure of inanimate matter on a solid. Avaunt, apophasis! Here is the syllabus—the scantling, as the Marquis of Worcester calls it—but look not so grave, gentle reader, there is not a "Century" of them.

First. To make a water-wheel (either overshot, breast, or undershot, it is alike immaterial) which, when once put in proper trim, and fixed in a sufficient pool or reservoir of water, shall work itself, together with any kind of machinery attached to it, within the limits of its power! The accidental waste of generative power (if I may so term the water), by the atmospheric evaporation, &c., may be sufficiently supplied once a week by a hand-pump or a water-cart. For your information, reader, I beg to state, that it is not the gimcrank concern which occupies the "front seat" of one of the early volumes of this work, nor is it any thing akin to him.

Secondly. Four different effective ways of placing the self-adjusting weights, No. 56 of the Marquis's scantling, suf-

ficiently powerful to drive *clocks, coffee-mills*, &c.!

Thirdly. A self-acting wheel, the weights of which are continually on the descending side, and never on the ascending:—however incredible it may appear, though the wheel constantly goes round, yet no sooner do the weights reach the point of gravity at the bottom, then you see them coming down the same side again!

Fourthly. A carriage, which being placed on common or rail-roads—prepared no otherwise than such roads are for other carriages—(though I should prefer a railway)—yet its own weight on this firm way, shall be the *primum mobile* of continued motion, liable to be varied in point of speed, turned or stopped at the pleasure of the guidesman—not like Mynheer Von Wodenblock's *perpetuum bobile*—uncontrollable! Shall I say further? The powers of locomotion are increased by the weight of the carriage.

Fifthly. A fixed engine on nearly the same principle: for any purpose to which *steam* is applied as a first mover,—as powerful, more economic, and void of danger!

And lastly. The reader must understand that I have *not* made any of the above machines; not that I suppose there would be any great difficulties in the way, further than such as are incidental to *first* model-making, as is cleverly explained in Babbage's "Economy of Arts and Manufactures;" but simply because I have not the means.

Speaking of Mr. Babbage, reminds me of his Calculating Machine, which, I believe, government is now, and has been for the last fifteen years, endeavouring to bring to perfection. Can any of your intelligent readers inform me, whether it would be possible to bring *my* machine under the notice of government?—always bearing in mind, that if I have not the pecuniary means of trying the engines myself, I cannot, of course, have it to fee counsellors, lawyers, and the numerous *et ceteras* connected directly and indirectly with the national government.

To be sure there is a wide difference between a scientific person like Mr. Babbage and an obscure individual such as I am; but Sir Isaac Newton, it is said, hinted something about a *fool* when *he* failed of discovering the perpetual motion. How far *I* may tally with the learned astronomer's ideas of one I know not, but certainly I have no ambition to contend for the title. Though the veteran mathematician did not express himself in the self-sufficient style of some of our *ci-devant* perpetual-motion-seekers after they had failed, 'Phoo! it's all fudge; there is no such thing. Hav'n't I tried it *all ways?*' yet I must say, it was rather ungenerous of him to place a disgraceful bar in the way of the successful student. I am not unaware, however, that many people consider me a downright ninny, for coming forward as I have done in a plain, open, decisive manner; but how far I may really merit the epithet, remains eventually to be proved. If, after setting up my name as a target for the arrows of criticism to be pointed at, it is clearly demonstrated that I am in error—then, indeed, I cannot but acknowledge the term will be very justly applied;—however, it may suffice at present when I say, "I do not fear the result!"

If there is no probability of government appointing a committee, or an engineer, to investigate the merits of the thing, is there not a chance of procuring some assistance from the Lords of the Admiralty, to whom (if my schemes succeed) they will be of great importance? Or would it not merit the attention of any railway company, especially that of the London and Birmingham, where there are so many tunnels?

As I am a young man, and ignorant of the proper method in which I ought to proceed, as regards the furthering my views in this way, I should feel obliged to any of your well-informed correspondents who will favour me with their advice on the subject.

I remain, Sir,
Yours very respectfully,
W. PEARSON.

AIRY ON GRAVITATION.

This respectable seven-shilling volume* is an offset from the *Penny Cyclopædia.* Professor Airy, it appears, had written it as an article for that very extensive work,

* Gravitation; an Elementary Explanation of the Principal Perturbations of the Solar System. By G. B. Airy, A.M., late Fellow of Trinity College, Cambridge, and Plumian Professor of Astronomy in the University of Cambridge. London: C. Knight. 1834. 8vo. pp. 224.

at a time, probably, when there was still some intention of keeping it within the limits originally assigned.* Seeing, however, that, at its present rate of progression, the letter G would not be arrived at for these ten years, at least, the learned Professor has sent forth the paper prepared for a penny pamphlet, in the shape of a goodly cloth-bound octavo! A strange metamorphosis, but not so unaccountable as may at first sight appear. It would have been too trying to the patience to have kept the treatise *in petto* for the benefit of the next generation (as it must have been according to the author's first intention): and, if the quantity and quality of its matter fitted it to make its appearance in a handsome separate tome, why not send it forth in that shape at once, and let the reading world of the present day reap the benefit of the Professor's labours? Besides this, our author has another, and a very excellent reason, for the mode of procedure he has adopted, which he could not have foreseen when he commenced his task. His explanation of this reason is well deserving of attention, as coming from a distinguished Professor of our great mathematical University:—

"The treatise was originally designed for a class of readers who might be supposed to possess a moderate acquaintance with the phenomena and the terms of astronomy; geometrical notions sufficient to enable them to understand simple inferences from diagrams; two or three terms of algebra as applied to numbers; but none of that elevated science which has always been used in the investigation of these subjects, and without which scarcely an attempt has been made to explain them. I proposed to myself, therefore, this general design—to explain the perturbations of the solar system, as far as I was able, without introducing an algebraic symbol.

"It will readily be believed that, after thus denying myself the use of the most powerful engine of mathematics, I did not expect to proceed very far. In my progress, however, I was surprised to find, that a general explanation, perfectly satisfactory, might be offered for almost every inequality recognised as sensible, in works on physical astronomy. I now began to conceive it possible that the work, without in the smallest degree departing from the original plan, or giving up the original object, might also be found useful to a body of students, furnished with considerable mathematical powers, and in the habit of applying them to the explanation of difficult physical problems. *With this idea, the treatise is now printed in a separate form.*"—P. vi.

It may well be suspected that the same discovery of the power of simplicity might be made in some other sciences besides astronomy—and the sooner it is made the better. Complexity is a thing to be avoided in education as well as in machinery—the fewer the wheels, the more perfect the machine; and the same with science, or with elementary science at least. Sir Thomas Lombe's silk-mill, with its 17,000 wheels, might excite more admiration in a gaping clown than a power-loom of the present day: but it could not stand the comparison a single moment in the eyes of any one qualified to pronounce a judgment.

How far the Professor has succeeded in his laudable object we can hardly take upon ourselves to determine; and we are sorry that our limits forbid us to give a specimen of his labours sufficiently extensive to enable our readers to draw their own conclusions on the matter. It would be useless to quote from that part relating to the very first lines of the science, by way of affording a notion of our author's mode of simplifying its abstruser portions; and one of the more advanced chapters (it would be unfair to give less) would occupy more space than could well be spared for its admission to our pages. We must rest content, therefore, with copying from the Preface a few excellent remarks on the great value of a recurrence to the elements of a science, even on the part of those who have made the highest advances in its highest branches. Professor Airy is (with perhaps a single exception) the most eminent English astronomer of his day; yet what is his experience on this subject?

"The exercise of the mind in understanding a series of propositions, where the best conclusion is geometrically in close connexion with the first cause, is very different from that which it receives from putting in play the long train of machinery in a profound analytical process. The degrees of conviction in the two cases are very different. It is known to every one who has been engaged in the instruction of students in the Universities, that the results of the differential calculus are received by many rather with the doubts of imperfect faith, than with the

* Eight volumes. The *fourth* is now publishing, and not one-fourth of the letter B has been got through!

confidence of rational conviction. Nor is this to be wondered at; a clear understanding of many difficult steps, a distinct perception that every connexion of these steps is correct, and a general comprehension of the relations of the whole series of steps, are necessary for a complete confidence. An unusual combination of talents, attainments, and labour, must be required, to appreciate clearly the evidence for a result of deep analysis. I am not unwilling to avow, that the simple considerations which have been forced upon me in the composition of this treatise, have, in several instances, contributed much to clear up my view of points which before were obscure, and almost doubtful. To the greater number of students, therefore, I conceive a popular geometrical explanation is more useful than an algebraic investigation.

* * * * * *

The advanced student, who exults in the progress which the modern calculus enables him to make in the lunar or planetary theories, perhaps hardly reflects how much of the power of understanding his conclusions has been derived from Newton's general explanations."—P. vii.

There is much in this that well deserves the attentive consideration of many, if not all, of our Mechanics' Institutions. It is to be feared that far too little regard is paid in that quarter to the great importance of cultivating the root of the tree of knowledge. In other words, too much indifference is displayed in well-grounding the members in the rudiments of the various sciences; and too great an inclination to "soar to the skies" at once. The candid confession of Professor Airy may have some effect in correcting this unfortunate tendency; for, if a return to the elements of his own peculiar science has contributed so much to "clear up his view of points which were before obscure," how beneficial must a similar process be to the *rather* less profound philosophers of a Mechanics' Institute!

Whether the communication has been accelerated by the publication of this treatise, we know not, but it seems the Professor has at length received the appointment of Astronomer Royal (at 800*l.* a year) vacant by the resignation (?) of Mr. Pond.

THE GURNEY JOB.

We have heard with inexpressible astonishment that the Select Committee of the House of Commons, to which Mr. Goldsworthy Gurney's claim to a national reward for his abortive steam-carriage speculations was referred, have recommended that a grant should be made to him of 16,000*l.*!!! The Committee must either have not investigated the case as they should have done, or they have been more mindful of the interests of the petitioner than of those of the public. Never was there a person who had less claim on the national purse. He has had already from private individuals for the promotion of his steam-carriage projects, more thousands than he can show to have been legitimately expended upon them; and, after all, he has left the matter of steam-travelling on common roads nearly where he found it. None of all the steam-carriage-adventurers of the day has been half so liberally supported with money,—none of them all has expended so much money to so little purpose. We hope the Chancellor of the Exchequer will pause before he gives the assent of the Crown to so unmerited a largess; if he will but look well into the case and judge for himself, the House of Commons may yet be spared the disgrace, of throwing more of the public means away upon one shallow schemer, than would suffice to bring a hundred really useful and meritorious inventions to maturity.

THE THAMES TUNNEL JOB.

House of Commons, 10*th July*, 1835.

The order of the day for the House going into a Committee of Supply having been read,

Mr. Walter said, that he had to call the attention of the House to a matter which involved one of the most essential of its privileges. It might perhaps be recollected that he mentioned, some time ago, the rumour of an advance of money to a certain Company called the Thames Tunnel Company. The suspicions which he (Mr. W.) originally entertained had been fully verified; the money had been obtained under the authority of the House, *but absolutely without its knowledge*. The first application made to the Treasury was in 1828. The Directors stated that they had then completed nearly one-half of the work under the bed of the river, but that the work was stopped for want of funds. (Hear.) The Treasury replied, that their Lordships did not feel that they would be justified in proposing to Parliament to afford assistance to enable the Directors to complete the work.—(Hear.) The Company again applied to the Treasury for aid in March, 1831, and were again refused. In October, 1831, the Directors once more memorialized the Treasury: they again said that nearly half the work was completed; that only 255,000*l.* was wanted to finish it; that they were authorized by the Proprietors to apply to the Commissioners for issuing Exchequer Bills in aid of public works for that sum, and to give such securities as might be required on the property, estate, effects, tolls, and revenue of the Company; *on condition, however, that the Proprietors should not be made personally liable to any further advance for completing the undertaking, in case the expense of the same should*

exceed the aforesaid estimate for such completion. The Lords of the Treasury directed that the parties should be informed that it would be premature on the part of the Lords to express an opinion till the object came recommended by the Commissioners for the loan of Exchequer Bills. In November, 1832, the Directors transmitted a new memorial to the Treasury, inclosing a bill, prepared by their Solicitor, to be presented on the ensuing Session, to extend the period of their powers, and introducing a clause giving sufficient authority to the Exchequer Bill Commissioners to make such advances as the nature of the undertaking might require. This memorial was indorsed "Thames Tunnel Company, for the sanction of the Crown to a clause in the Bill authorising the loan of Exchequer Bills without requiring personal security for the same." The answer to this last memorial was, that the Company were at liberty to introduce the clause, but that it must be so framed as not to commit the Exchequer Loan Commissioners, or the Treasury, in their final determination. The Bill introduced into Parliament, to which he referred at the outset, passed the House in August, 1833, but nothing was done upon it till July, 1834, when a new memorial was sent in, praying the Treasury to send a warrant to the Exchequer Bill Commissioners, authorising them to issue Exchequer Bills, or advance money to the memorialists, to the extent of 246,000*l.* upon the security mentioned in the said Act, to be repaid with interest, out of the profits. The Lords of the Treasury hereupon requested the opinion of the Commissioners for the loan of Exchequer Bills, as to the arrangements which should be thought necessary, in case their Lordships should be disposed to exercise the discretion vested in them. The Commissioners, in reply, advised that the advance should be first applied in completing the most hazardous part of the undertaking; they recommended that the money should be given by instalments, and the progress of the works watched as they consumed the instalments; but the Commissioners were wholly silent as to any investigation into the nature of the securities offered, feeling themselves, no doubt, precluded, by the wording of the Act, from instituting such an inquiry. The final minute of the Treasury is dated October the 10th, 1834, wherein the Lords at last authorised an issue of 30,000*l.* Such were the proceedings of the Treasury. He now would show the manner in which the positive refusals and protracted reluctance of the Treasury and the Exchequer Bill Commissioners to part with any money upon such a scheme had been baffled and overcome by the unfortunate, and what he might call the unconscious intervention of Parliament. A very few days after the meeting of the first reformed Parliament—viz., on the 19th of February, 1833, the first step was taken; and he (Mr. Walter) should read the history from the journals, for he had no information except from that source:—"1833, February 19. Petition of the Thames Tunnel Company, praying leave to bring in a bill to amend, extend and enlarge the powers and provisions of the former Act, and to enable the company to raise a further sum of money. To be referred to a Committee, Mr. Gillon, &c., and to have power to send for persons, papers, and records." "March 22. Mr. Hawes presented a Bill to amend the Acts relating to the Thames Tunnel Company, and to extend the powers thereby given for raising money for the completion of the said tunnel. And the same was read the first time." "April 1. A Bill to amend the Acts relating to the Thames Tunnel Company, and to extend the powers thereby given for the completion of the said tunnel, was read a second time and committed to Mr. Hawes, &c." "May 17. The Bill, with several amendments, is reported, and the report ordered to lie on the table." After this the Bill appeared to have been "hung up" till August, with what view he (Mr. Walter) would leave the House to judge. In August, however, and amidst the hurry and confusion of a closing session, the Bill was got through. The money which had been advanced, and which he had no doubt was lost, was not of so much consequence as the deviation from the established law of Parliament. He believed it to be the rule of the House that money should not be granted without the leave of the House; and this Bill, authorising the payment of 270,000*l.*, had been got through totally without the knowledge of the House, under the disguise of a private Bill. To talk about security was ridiculous. The parties are screened from liability themselves, and the country was told it might have the works, which would be totally unproductive. A tunnel might be made, no doubt, in various ways, but at what expense? Nearly 200,000*l.* had been already wasted; 270,000*l.* more was asked for by the Act complained of; and when that was spent, he would venture to say that another 270,000*l.* would then be found necessary for its completion. He stated this on no light authority. The money already given was totally thrown away, unless the House were content to vote at least half a million more for this project, which was carrying on, in more senses than one, *in the dark*, respecting which the Government had no information whatever, except such as it derived from the parties receiving the money, and who had been misleading the public from the very commencement of the undertaking. He could not conceive that the House would knowingly make such an improvident grant of the public money. Before he sat down he would read a communication which he had received from a gentleman who took a great interest in the building London-bridge, and who firmly believed the proposed tunnel would never be completed. "They had not yet got," he said, "to the worst part of the river. Experience obtained in building the new London and Southwark-bridges had proved that the soil on the northern side of the river is springy, liable to quicksand, and in every respect more dangerous and difficult to work than the southern or Surrey side, on which the work has been commenced. To insure a reasonable prospect of success, the tunnel ought to have been made several feet deeper. The work never could be accomplished without coffer-dams, and there is no timber long enough to make the piles in that part of the river. Timber from 55 to 60 feet long might be obtained fit for that purpose, but not longer, and it was with the greatest difficulty that timber of a sufficient length was obtained for the coffer-dams at New London-bridge. A Committee to examine practical engineers would be very desirable. The coffer-dams would cost all the money at present advanced, and would interrupt the passage of the river, if not wholly stop it." Another individual had informed him that when the water broke in, there were only about seven feet of soil between the tunnel and the wash of the river. The most difficult part remains to be done. The channel of the river is on the Middlesex side. The tunnel is, therefore, about to approach a part of the river deeper than that under which it is at present, and therefore with less soil to cover the tunnel. The Hon. Member concluded by moving—"For a copy of any document under the authority of which the advance of the sum of 30,000*l.* had been made to the Thames Tunnel Company; and for copies of the reports, if any, of professional persons made before the money was advanced, respecting the existing state of the Tunnel, the estimated cost of completing the same, and the probability of future repayment."

Mr. Hawes (one of the Directors of the Thames Tunnel Company) said, that the Hon. Member was altogether wrong in supposing that the sums referred to had been advanced on the authority of any Bill framed for that particular purpose. The facts were these: a sum of 1,000,000*l.* had been placed at the disposal of the Commissioners to be applied to the carrying on or in aid of public works. Of that 1,000,000*l.* 30,000*l.* had been advanced on the usual terms, and under the sanction of the Treasury; he was therefore warranted in saying

there was not the slightest irregularity in any part of the transaction.

The Chancellor of the Exchequer fully acknowledged the right of inquiry, and should not therefore offer any objection to the production of the papers called for.

The public are much indebted to Mr. Walter for bringing this affair under the notice of Parliament. We may now be pretty certain that, though the 30,000*l.* cannot be got back, there will *be no more of the public money* thrown away upon this desperate speculation. Mr. Hawes (who, besides being a Director of the Tunnel Company is related by marriage to Mr. Brunel), pretends that the 30,000*l.* was not advanced under any particular Act of Parliament in favour of the Company, but by the Commissioners for the Loan of Exchequer Bills on Public Works, in virtue of the general powers vested in them. It may be very convenient to give this turn to the matter, now that there is a noise made about it; but we suspect the Honourable Gentleman will find it rather difficult to make good his assertion. That an Act was smuggled through the House in the way described by Mr. Walter, authorising the Exchequer Bill Commissioners to advance 247,000*l.*, is not denied. Why, then, should the 30,000*l.* have been advanced under the general powers vested in the Commissioners, rather than under this special Act for the purpose? Of what use was the special Act if it was not to be acted upon? It appears to us perfectly clear, from Mr. Walter's narrative, that both the Lords of the Treasury and the Exchequer Bill Commissioners supposed that they were acting under the authority of the special Act. We must, also, take the liberty of reminding Mr. Hawes, that this was the version of the matter given by that gentleman himself and his brother Directors, *at the time*—though now they deem it more advisable to go upon another tack. On the 3d of March last, there was an annual meeting held of the shareholders of the Tunnel Company, and the following is an extract of the proceedings as given in the *Times* of the 5th of March following:—

"The Chairman said the Directors were pleased to meet the Proprietors under rather different circumstances than for the last seven years past, as *the* GOVERNMENT *had placed in their hands* a sum of money which the Company's engineers thought would *be sufficient* TO COMPLETE *the tunnel*. The advance *had been made* to the Company in Exchequer Bills, and they would, therefore, have the advantage of the premium. The Company were, under these circumstances, much indebted to the late Government, as well, indeed, as to the present, for this aid. Great credit was due to all those who had advocated the grant of money; and among those who had formed the deputation to Government were men of all parties. The time was not now far distant when it was confidently believed this magnificent work *would be completed*, and some return made to the Proprietors for the money they had advanced.

"The Report of the Directors was then read, stating, that 247,000*l.* *in Exchequer Bills was to be advanced to the Company, on the security of their property.*"

Not a word, the reader sees, of 30,000*l.* only, or of "general powers," or any thing of the sort. The sum for which the Directors profess themselves to be everlastingly beholden to the Government is the identical 247,000*l.* authorised to be advanced for the *completion* of the work by that special Act which Mr. Hawes *now* affects to regard as a dead letter.

The next time Mr. Walter moves in the matter, he should call for a copy of the Report which the Directors are stated, in the preceding extract, to have made to their constituents in March last. That would probably establish the real state of the case beyond all denial; and place, at the same time, the conduct of the patriotic Member for Lambeth in a light more to be lamented than envied.

NOTES AND NOTICES.

Cultivation of Silk in England.—A company has been formed in Norwich for rearing silk-worms. They are possessed of 120,000 of these valuable insects, in a most healthy state, and have planted 1,000 mulberry trees for future provision. In the mean time contributions of mulberry leaves have been liberally afforded by many gentlemen who are desirous of encouraging the undertaking.

Important Chemical Discoveries.—We are requested by a learned Professor in Germany to invite the attention of our chemical manufacturers to the following valuable chemical discoveries:—1. A new method of preparing white lead, by which a much finer and whiter article than the best Dutch or English white lead is produced in a great deal less time, and with much less labour. The advantage is, at least, equal to 40 per cent. The method is now in successful operation in three manufactories on the Continent, but is as yet unknown in England.—2. A method of obtaining a vinegar from wood, equal to the best wine or table vinegar.—3. A printer's ink, of extraordinary purity and cheapness.—And, 4. A method of preparing yeast equal to the best yeast from malt or beer, at half the cost.—The inventor is desirous of disposing of all or any one of these inventions; and will, if desired, forward specimens of the articles. Any communications on the subject, addressed to the care of the Editor, shall be duly forwarded.

Communications received from A. R. W.—Q. Xanthine—H.—W. M. P.—Enort—R. F. A.—Mr. Whitelaw.

Errata.—P. 260, col. 2, l. 44, after "687 of the principal inhabitants" add "of Portland."—In the signature to Mr. Woodhouse's article on Angular Railways, p. 281, for "P. Woodhouse". read "Jas. Woodhouse."

Our Publisher will give One Shilling and Sixpence for copies of the Supplement to Vol. IX.

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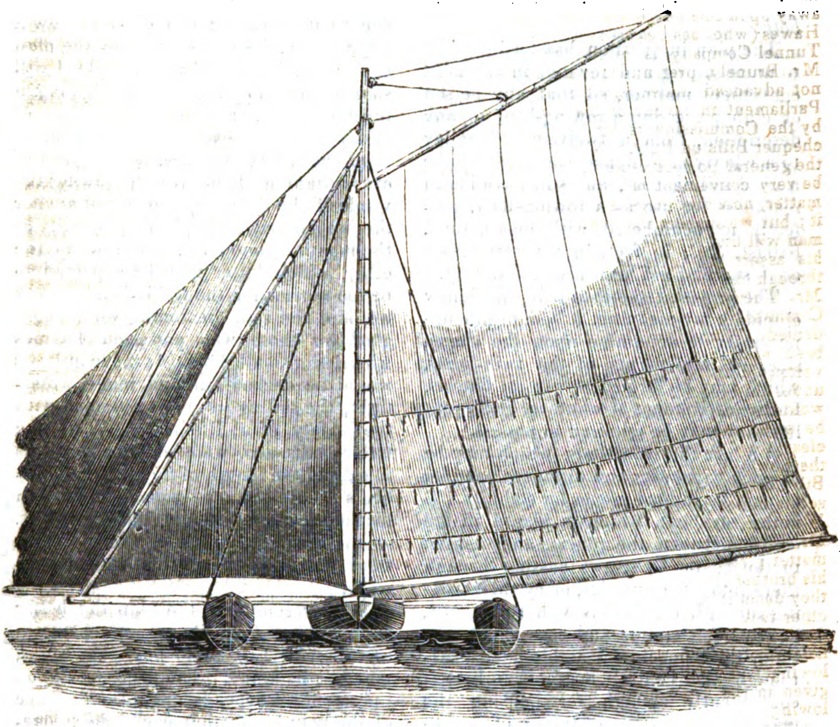
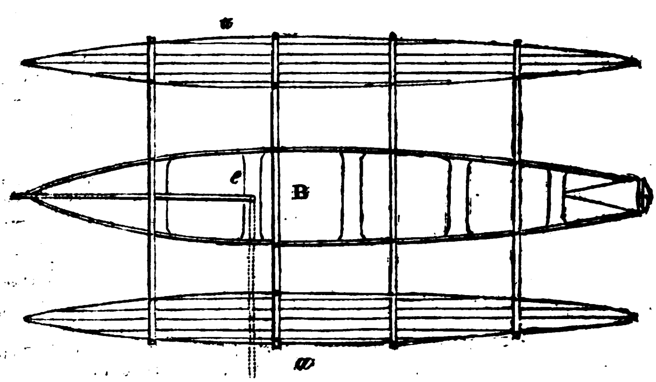
SAILING AND ROWING TREBLE BOAT.





SAILING AND ROWING TREBLE BOAT.

Sir,—I beg through the medium of your valuable journal to show to the public one way by which the principle of twin-boats may be applied, if not to any extent of usefulness, at least in making an addition to the recreations of amateurs in rowing and sailing, and, therefore, recommended to those who are fond of *both*.

The plan in question has for its object to unite sailing and rowing, in the most convenient manner, so that any person or club possessing a rowing-boat of any description, from a twelve-oared galley to a wherry or skiff, may contrive to make a good sailing-boat, and still have her in readiness for use as a rowing-boat, perfectly unencumbered with masts, sails, ballast, &c.; in fact, in the same state as if she had not been used for sailing.

The proposed sketches will sufficiently elucidate my meaning, it being quite unnecessary to determine upon the shape, size, or dimensions, of the twin-boats, which may be formed to suit all fancies, for the attainment of whatever good quality they may be required to possess.

A A are the twin-boats, which may be of such capacities and distances asunder as may be judged proper for stability. B is the row-boat, which is placed in the centre between the others, and secured to the beams by screws passing through them into her gunwales, or by their passing through the beams with screw nuts, or any other simple and convenient method, thus forming a treble-boat. Although the central boat offers herself conveniently enough for housing the mast, I do not take advantage of it, because it would be a hindrance to using the boat with dispatch; besides, it is of little consequence, as owing to the great spread of the rigging, very little housing would be necessary, a wooden shock fixed to one of the beams, or a low thwart from one beam to the other, would answer every purpose. Fig. 2 shows how she may be rigged as a cutter, for instance, and she is represented as sailing directly before the wind, with her bowsprit, containing her fore-sail and jib spread over on the opposite side of her main-sail, which is made to revolve at its inner end C, fig. 1; and when the boat is sailing upon a wind, it is secured to the stern by a clamp, by which method the necessity of a square sail is avoided, a plan of this nature being manageable enough upon a small scale; however, as the rigging part has nothing to do with the first intention of the plan, I leave that entirely to the judgment of the amateur.

After the above explanation, it will be readily imagined that the central boat is always in a state of readiness, and when it is considered that the largest class of yacht cutters cannot conveniently stow a large galley, the convenience of the plan is obvious; by way of an example, I will suppose a club of gentlemen having a rowing galley, and being desirous of making a long excursion coastwise, or from one river to another, now instead of over-fatiguing themselves by rowing the whole of the distance, they might anchor the treble-boat in a place of security at the mouth of one river, and row up the other, which latter may be supposed to be too narrow for the treble-boat to work up, and the same reasoning would hold good for those who possessed Thames wherries or small skiffs. As the twin-boats would be decked out and made water-tight, the sailing would be attended with the safety of a life-boat. When the treble-boats, too, were on such scale as to exceed the length of 25 feet, the twin-boats would then be capacious enough for the accommodation of sleeping-berths, —small cabins, as their owners might think fit, properly shut in with hatchways.

I can recommend the plan the better from having *tried it*; therefore, an observation or two, as to how she works, may not be amiss. The display of good judgment all depends upon the distance of the twin-boats from each other, together with their capacities suiting whatever weight of mast, rigging, and quantity of canvass it is proposed to give the boat.

Should the twin-boats be of small capacities and too far asunder, the longitudinal stability or liability to turn over in sailing before the wind may be less than the lateral, or that required in sailing upon a wind; this is the point in which the stability differs so widely from single boats. I have read in some publication that it would be next to impossible for a twin-boat to be upset, but that is a fallacy, as *any vessel* may be masted and rigged in proportion to her stability, which I have learnt by experience for having so masted my treble-boat, as to oblige me to take in reefs when others

vessels did, I was once all but upset; the lee boat was apparently entirely submerged, and it is clear that the maximum of stability must be in that situation, with the whole weight of the weather-boat suspended in the air, when, if sail be not immediately reduced, a rapid capsize must follow, unlike to a well-ballasted boat which would be finding her equilibrium. It is true that a treble-boat may be under-masted for her stability and still answer every purpose, and then her comparatively superior stability would become her best coasting quality, and if with a moderate breeze she outsailed every other boat of her length, that would certainly be the most prudent course to adopt. I only mean to remark, that treble-boats similarly to single ones may be adapted either for safety, convenience, or racing, and that many good qualities are only attainable but at the expense of others.

The experience which I gained with my treble-boat (14 feet only in length) was, that in sailing free or before the wind, she flew past every other boat, and she forereached and worked well to windward, but did not hold a better wind than in common, which I ascribed to the circumstance of her stability having been gained by great breadth of beam with no weight of ballast, and, consequently, her presenting above the water-line so much more surface of hull than a well-ballasted single boat would have done; however, there is no determining upon the achievements of a boat of larger dimensions than mine. I had only two strong beams to unite my little treble-boats together; of course, longer boats would require more, but it is only on a large scale that it would be indispensable to resort to stronger combinations of unity, as diagonal trussing, &c. As it is advantageous to have the twin-boats a good depth, and, at the same time, a proper height out of the water, I should recommend to any person who may construct one upon a large scale, not to mind, should the height of the beams require the central boat to be lifted out of the water, or merely to skim upon the surface, when she is bolted to them, as she would not add much to the stability, but on a small scale she cannot so well be got rid of, and her services must not then be despised.

Notwithstanding my having said that the present plan can only benefit the recreations of aquatic amateurs, that I might not appear to give it more importance than it merits, I think that it is one of the many of those plans which every naval officer should make himself acquainted with, to enable him to have recourse to, in case of need. I can conceive many situations a ship may be placed in, which would call it into action, especially in the survey of coasts and rivers in foreign parts, when at any time with the materials she had on board, a ship's cutter might form the central boat of a very respectable treble one, possessing all the advantages already pointed out. Again, if a ship were stranded on a desolate coast without the loss of her materials, she could make all her boats treble ones with sufficient capacities to convey the whole of her crew with a certain quantity of provisions and water, to any other place of safety.

I cannot conclude without remarking, what a pity it is that a book containing nothing but naval inventions and plans relating to nautical matters, has not been published for the exclusive use of seamen, as many plans, particularly "make-shift" ones, which have answered admirably, and others which have been proposed are buried in oblivion, leaving the officer in the time of difficulty to the resources of his own mind, unassisted by the labours and experience of the many.

In the hope that I have sufficiently explained the plan, and that the above hint may be taken by some one of your intelligent readers who may have the means of compiling a work of the kind,

I remain, Mr. Editor,
Your faithful servant,
⊕

June 12, 1835.

THE "PLAN FOR PROPELLING STEAM-VESSELS BY THE RETROACTIVE FORCE OF A COLUMN OF AIR." (P. 264.)

Sir,—After a careful perusal of the article, entitled, "Plan for Propelling Steam-Vessels by the retroactive Force of a Column of Air," and taking for an exemplification a paddle-board whose superficial area is 12 feet, we come to these conclusions:—1st. That to have an equal surface in the "air" apparatus, the discharge-pipe must be 4 feet in diameter, or $\frac{1}{4}$th that of the air-cylinder. 2nd. That the air must not only be compressed

to ¼th of its original volume, but to $\frac{1}{16}$th of the same. 3rd. That as the paddle-board must go at the rate of 1,000 feet per minute (or five times that of the piston), therefore the air must go at such a proportionate velocity, so as to produce an effective power equal to a given surface, leverage, and the moving power of a paddle-wheel-board. And, 4th. That the air which has to strike against a given surface of water, must go at the rate of 200 times the velocity of the water itself, *i. e.* taking into consideration the compressibility of the two fluids.

There are many other objections against this principle of the "air" striking a body of water. For instance:—should the water be low, the air will bubble through, and would have no effect upon the water to drive the vessel either way; nor would such a plan answer at sea; for if the discharge-pipe, or trunk, were fixed parallel to any part of the vessel, as soon as a gale of wind comes on, and the vessel begins to rise and fall, the aperture of the pipe would meet the wind instead of the water.

I am, Sir,
Your obedient servant,
MOHAMMED AL MOONGHEE.

Woolwich, July 6th, 1835.

ON RAILWAYS. BY JOHN HERAPATH, ESQ. NO. VII.

Sir John Rennie's Railway to Brighton and Shoreham.

Sir,—I regret that incessant engagements should again interrupt the observations I intend to continue on railways. However, I have determined that nothing should prevent my noticing the very droll article in your last, No. 623, on the southern lines, by a Mr. James Combe, "Civil Engineer," especially as I have been fortunate enough, I think, to trace out its origin.

Truly, Mr. Editor, the public are much indebted to you for the skill with which you intersperse the amusing with the instructive, the ludicrous with the serious. It is this good tact, I suppose, which makes your Journal so much read, and gives it such extensive circulation.

"Who," said I, the other day, to a civil engineer of eminence, "is Mr. James Combe, civil engineer?"—"I don't know," was the reply. The same question elicited the same answer from a second, third, &c. At length, a gentleman informed me that he believed he was one from Sir John Rennie's office, and a pupil of the worthy Knight. Of course, all mystery at once vanished, and I immediately conjectured, but do not like to be positive, that he might be one of those gentlemen who come, like herrings, in shoals from the North, pay 3, 4, or 500*l.* premium, read the daily papers, smoke their cigars, look at an old theodolite, get a few technical terms, lay aside their tartan petticoats, cover themselves decently with breeches, and, after three or four months, step forth into the world complete at all points from that most perfect of laboratories, Rennie's, for the manufacturing of civil engineers. It also followed, that Mr. Combe being Sir John's pupil, and in his office, the letter signed James Combe was written with the privity and knowledge of the said Sir John, if not by the Knight himself. It is with him, consequently, that I consider I have now to do.

This gentleman begins with telling us, that he is "personally acquainted (which is more than Mr. Herapath pretends to be) with the engineering details of the subject." Now what, in the name of common sense, have the "engineering details" to do with computations of the working merits of the rival lines, which are the subjects of my letter? Certainly, Sir John's good sense must have been lost in one of his dark tunnels, or he would not in such a case talk of "engineering details." However, we shall shortly find that, whatever may be his knowledge of "engineering details," his ideas of the true principles of a railway are singularly unique.

"In judging of the skill," says the writer, "with which this line has been laid down, it must always be remembered, that every other consideration was made subordinate to that of *distance.*" Here is a confession! The old-fashioned notions of humouring the country in railway designs, on the principle, *that railway distances are not to be counted in miles, but in hours and minutes, that the line in which the time of transit,* cæteris paribus, *is the shortest, is the least expensive to be worked and the most profitable in its returns,* are, then, all nonsense, and the rest of the world, the advocates of these notions, blockheads. The only

true principle and test of skill, it seems, in laying down a railway, are to find the places on a map, draw a right line with a ruler from one to the other, never heeding the expense, or what is in the way—all must be "subordinate"—whether mountains, hills, vales, or volcanoes; rivers, lakes, or fathomless gulfs; houses, palaces, churches, or steeples—for "the question," says Sir John, or his defender, "is not whether it is the most level line, and the freest from locomotive difficulties," *(hear! hear!)* "that can *any where* be found between London and Brighton," or, I suppose, any other town, "but whether, taking the *shortest* course from *point* to *point*, any *better* could have been *selected*." Now, seriously, Mr. Editor, could human ingenuity have contrived a more effectual mode of covering Sir John Rennie with ridicule than his champion and defender has? First, credit is claimed for skill in making every other consideration bow to distance, that is, in drawing a straight line; secondly, levelness and locomotive difficulties—the prime objects and stumbling-blocks of other engineers—are all to be thrown aside as of no account; lastly, after making it a principle to have "the shortest course from point to point," which Euclid tells us is a right line, the absurdity is crowned by talking of selection, as if there could be any choice where there is but one object!!

Your journal, sir, appears to me to be like "Liberty Hall," in which every man, who will not take good advice, may make himself as ridiculous as he pleases. This may be all fair, but then I submit he should not scatter his absurdities with unbounded prodigality over others. It is for this reason that I pass the long fanfaronade about a Committee having "decided upon adopting," but wisely "deferred" applying to Parliament for a Bill, to construct the line some naughty men now call "Rennie's bo-peep line." It would be a libel on common sense to suppose they were serious in expecting a Bill, as it would be the height of folly in gentlemen to think of making such a road for ladies, unless they barbarously meditated exterminating their lovely victims by steam, smoke, and terror.

After the samples we have had of the absurd and ridiculous in Sir John's defence, we cannot place much confidence in its details, a few of which, as rare specimens, I shall here subjoin. The writer says, p. 291, Mr. Herapath affects to hold in horror "*groping the whole of his way*" (47 miles) "*in the dark*;" my words, p. 197, are, "*aggregating 7 miles of groping in darkness in only 47 miles*." Thus the difference is only 40 miles, or 470 per cent. more. Again, he says the total length of the tunnels is under 2¼ miles. Now, it has always been understood and publicly said, that the Messrs. Rennie's line contained 10 miles of tunnels. My authority, by Mr. Julian, professed to be taken "from Messrs. Rennie's plan, dated Nov. 29, 1834," gives 9¼ miles; and another gentleman I have conversed with this day (July 20), whom I understood to have seen the plan, said the longest tunnel was near 2½ miles, that is, a quarter of a mile longer than Sir John allows the whole to be. It may be asked how I came to depart from my authority, and to call the tunnels only 7 instead of 9¼ miles. The truth is, except the inclinations, with which I could not meddle, I understated every thing. I took 100 feet from the height of the hills, another from the embankments, and 2¼ miles from the length of the tunnels. In fact, the project altogether appeared so monstrously absurd, that I was afraid to tell the whole, lest the public should think I was romancing.

Sir John, or his agent, Mr. Combe, goes gratuitously out of his way to state some hearsay reports of Mr. Robert Stephenson against Mr. Cundy's levels. I am no defender of Mr. Cundy's accuracy. Doubtless, he can equal any of his brother engineers in errors—always, however, deferentially excepting Sir John Rennie and Mr. Combe—but why blame him? He depends on those he employs in the same way as other engineers do, and is therefore exposed to precisely the same difficulties. What I know is, that I have spoken with two gentlemen, one of them a surveyor, who well knew the country. I have conversed with the gentleman who surveyed the line and neighbouring country; I have heard the observations of another engineer, no friend to Mr. Cundy, who has gone over the line; and they one and all concur in saying, that it is the best and only good line to Brighton. For my part, I shall hazard no opinion of the line or its levels, unless I actually see and survey it.

In conclusion, I beg to observe, that

truth only is my object. I know not Sir John Rennie, his friends, or his foes; and what I have written has been without the slightest particle of prejudice. I may add, that Sir John's friendship I might have valued, his enmity I should not. Had he therefore have privately written to me, I should promptly have obviated any cause of complaint. But since he has thought proper (for I feel satisfied it is he himself) to enter the field of public contention and attack my veracity, I have received the onset in the same temper Louis Philippe did the wild rising of some Parisians, whom he dispersed by sprinkling a little cold water over them. Indeed, when I was poring over this defence, reply, or whatever it is called, for the purpose of finding something good or exculpatory, I could not help comparing myself to the poor Welshman, who, being found one cold morning busily stirring a steaming dunghill, exclaimed—"Ah! hur wanted to light hur pipe, but, yes indeed! I see hur is all smoke and no fire."

JOHN HERAPATH.

Kensington, July, 1835.

LORD BROUGHAM'S PATENT LAW AMENDMENT BILL.

This Bill, after undergoing some alterations in Committee, has passed the House of Lords, and was read a first time in the House of Commons on Thursday the 16th inst., but at so late an hour, that the introduction of it was not mentioned in any of the Parliamentary Reports of the daily papers.

The history of the Bill so far is curious. In 1833 the House of Commons passed a Patent Law Amendment Bill, which, in the judgment of so many of the members as troubled their heads about it, was just the thing called for. We ventured at the time to say, that this "just the thing" was as absurd and pernicious a measure as could well have been devised, and were at some pains in a series of articles to establish the correctness of this our opinion of it. When the Bill reached the House of Lords, we had the pleasure to find their Lordships much of the same mind respecting it as ourselves; Lord Brougham, the then Chancellor, declared that the Bill was so extremely faulty, that it could not be entertained for one moment. His Lordship promised, however, to apply his mind to the subject, and to bring in such a Bill himself as should accomplish all the reform that is needed in this branch of the law. And hence Lord Brougham's Bill of the present session, which now awaits (in its turn) the decision of the House of Commons, and is destined (so much we venture to predict) to experience a similar fate with the former Bill, and scarcely less deservedly. When this Bill was brought into the Lords, it was referred to a Select Committee, which proving a little more restive than was probably expected—refusing to sanction the Bill until a case had been made out for the particular sort of amendment proposed by it—Lord B. was obliged to have the Bill recommitted for the purpose of doing his best to make out such a case. If we are rightly informed, however, the only witnesses called on the recommittal of the Bill were, 1st. the solicitor to the rejected Bill of 1833, who, saving his share in that abortion, had no call to bear witness on the subject, having confessedly no practical experience of the evils to be redressed; 2d. a gentleman who has raised himself by his inventions and patents from a very humble condition in life to affluence and distinction, but who for the very reason that he has been so fortunate, is but an indifferent judge of the difficulties which the generality of poor inventors have to encounter; and, 3rd. a consulting engineer of considerable standing, who went prepared to occupy the Committee for a couple of days with his crotchets and speculations, but who was civilly dismissed after a few questions asked and answered, and who, it must be confessed, was likely to have been more verbose and tedious, than either pertinent or edifying. But *three* witnesses, in all, to sustain a Bill, which proposes to make an entire change in a law which has existed as it is for more than a couple of centuries, and which is deeply to affect the interests of a numerous and most hardly dealt with portion of the community! And such witnesses, too—not one of them a sufferer from those evils which it should be the business of any reform in this quarter to redress—not one of them qualified by personal experience to tell where the shoe most pinches!—Examined, moreover, in private—for in Select Committees, such as that to which this Bill

was committed, the proceedings are conducted with closed doors; no opportunity given to persons interested in the Bill to know what sort of evidence was given, to refute any false representations that may have been made, or counteract any erroneous opinions that may have been delivered. The evidence, however, such as it was, seems to have removed the difficulty that stood in the way of their Lordships; the Bill was now allowed to go through the remainder of its stages, *sub silentio*; and so in due season we now find it on the table of the Lower House, waiting a second reading.

We subjoin a copy of the Bill as it has been sent up from the Commons, that our readers, by comparing it with the copy which we gave of it as first introduced (see p. 221, of our present volume), may see the alterations which have been made in it in the interval, and may judge for themselves how far it is open to the objections which we now proceed to make to it.

The principal grievances of which inventors have to complain are briefly these:—

First: The enormous Expense of Patents.

The cost of a patent for a new invention for England, Scotland, Ireland, and the Colonies, is, including the specifications, seldom short of 400*l.* The cost of entering a new book at Stationers' Hall is only half-a-crown. Inventors are taxed as no other subjects of the Crown are taxed—taxed to an extent which is in all cases oppressive, and amounts in many to absolute interdiction.

Second. The Short Duration of Patents.

The author of any new book or pamphlet—new song or ballad even—is entitled by law to the exclusive copyright thereof for the space of *twenty-eight* years certain; and for as much longer a period as he may be in life after the lapse of the twenty-eight years. But the inventor of any new instrument, machine, or process, in the arts—no matter how valuable—is only allowed an exclusive property in it for *fourteen*. In the eye of justice, though not of law, however, the claims of both stand on precisely the same foundation.

And, *Third. The vexatious Multiplicity of the Forms of Procedure in taking out Patents.*

Most of these forms of procedure exist *for the mere expense sake*, and for no purpose of public utility whatever. Three separate patents and specifications are required for the three kingdoms, when one for all three might and ought to suffice.

Now, of these serious grievances, neither the *first* nor the *third* is at all touched by Lord Brougham's Bill. On the contrary, it would tend, if passed, to aggravate both, inasmuch as it proposes to superadd certain new forms, which would necessarily bring both expense and trouble along with them, and place protection to the poor inventor still further from his reach than ever. And though the *second* grievance does form the subject of one clause in the Bill, the degree of relief proposed to be afforded is so small as not to be worth caring for. It amounts to this, simply, that instead of an expensive course of proceeding before the two Houses of Parliament, to obtain an extension of the term of a patent, an inventor shall go through a somewhat less expensive course of proceeding before the Judicial Committee of the Privy Council. When a patent, however, has become of such value as to make it worth while to apply for an extension of it, a few hundreds, one way or the other, count for but little. It is seldom in *that stage* of an inventor's history that *expense* is of any consequence. We object, however, to *needless* expense in any stage. We are of opinion, that justice and expediency alike require that the duration of *all* patents ought to be greatly extended (for more reasons than may probably suggest themselves, at first sight, to the reader, or than we have room at present to explain) —that inventors should, at least, be placed in this respect on an equal footing with authors—and that were the ordinary term of patents only made as long as it should be, such a thing as an application for an extension of the term would be no more heard of—just in the same way as we never hear of a petition for an Act of Parliament to extend a copyright, because the law, as it stands, allows copyright enough.

Although Lord Brougham's Bill steers so marvellously clear of the *real* grievances belonging to the case, it shows no want of boldness in dealing with what we may truly call the *imaginary* ones.

One of these is the impossibility, under the existing law, of amending a specifica-

tion after it is once enrolled. There has been an outcry raised on this head for which we have never been able to discover any rational grounds. We suspect it can be traced to no better sources than to two or three individuals who, quitting their proper occupations of trunk-making, globe-making, and the like, have thrust themselves (favoured by accidental circumstances) into the business of preparing specifications—a business requiring some *little* knowledge of both science and law, and for which, as it happens, they are wholly unqualified—and who are, therefore, naturally anxious to cast on the state of the law, the blame of sundry blunders which ought more truly to be attributed to their own gross ignorance and incompetency. To such persons a law that would enable them to disclaim and alter, and disclaim and alter again and again (for Lord Brougham proposes no limitation) would be a perfect God-send; and of the Bill before us they are, of course, great approvers. Now, the best way to *test* this outcry is evidently to inquire on what grounds patents have been hitherto found by the Courts to be invalid, in consequence of defects in the specification. We do not know whether Lord Brougham did so before he brought in his Bill, or whether the Select Committee of the Lords did so when that Bill was before them—indeed, it is tolerably certain they did nothing of the kind—but we have ourselves gone through, more than once or twice, all the cases in the books which have turned on the interpretation of the specifications, expressly with a view to this particular question; and we have not met with one in which the defeat of the patentee was not entirely owing to some *culpable* incorrectness or insufficiency in the description of his invention. Where, then, is the great evil to be remedied? We look upon the law as it stands on this point to be nearly unexceptionable. Some protection against pure inadvertencies, or mere clerical errors, ought perhaps to be provided, but beyond this no alteration of the law ought in our humble opinion to go. The exclusive privilege which the law gives for a term of years is something extremely complete; and so also ought the disclosure to be, for the sake of which it is conferred. To encourage laxity in this respect would be to open a door to boundless abuse.

But what after all is Lord Brougham's remedy? A patentee may *disclaim* and he may *alter*, but nothing more. He is not to be at liberty to *add to*, and by that adding, *to amend*—(in nine cases out of ten the thing most wanted.) But if at liberty to *alter*, which would be a liberty of substituting one thing for another, why ought he not to be equally at liberty to *add* one thing to another for the sake of making that other perfect? For instance, in the case of Liardet *v.* Johnson, a patent was declared to be invalid, because the plaintiff, who had invented a new truss, had omitted to state in his specification that he rubbed his steel-springs over with tallow, which was proved to be essential; now such a defect as this could not be remedied under Lord Brougham's Bill. It may be said, perhaps, that all *additions* virtually resolve themselves into *alterations*; but is this so clear that there could be no wrangle about it among the gentlemen of the long robe? And if it had been the intention of the framers of the Bill to allow of additions, why not say so at once in express terms?

Another *imaginary* grievance for which the Bill proposes to provide a remedy is, that of a person taking out a patent for an invention which he afterwards finds has been previously invented or used by some one else, though not "*publicly and generally used.*" The Bill provides, that if in such case it shall appear to the Judicial Committee of the Privy Council that the patentee "*believed* himself to be the original inventor," they may report to his Majesty that he should be entitled to new Letters Patent, which "shall be available, in law and equity, to give to such petitioner the sole right of using, making, and vending such invention as against all persons whatsoever, save and except such person or persons as did use the same invention before the date of the first Letters Patent, and those to whom he or they may give leave to use the same, any law, usage, or custom to the contrary notwithstanding."

Fine legislation this! How is the *belief* of a pretended inventor to be arrived at? How the negative to be proved that he *did not know* of the thing being invented before? What is there in the heads of the Judicial Committee of the Privy Council (even since Lord

be joined them) which should enable them to do what was never yet accomplished by mortal tribunal? Suppose, again, that a person who has previously invented and used an invention for which a patent is taken out, has also, from a desire to benefit the public, sent a description of it to some scientific journal. That might or might not extend the use of it beyond that person; it might remain recorded there without any second person giving it a trial (as thousands of valuable inventions have done for a time), and in that case there would be no such public and general use as this Bill contemplates. Now, though thus published—made a present of to all the world by the first inventor—all the world might be cut out of the use of it by any single individual who, on reading the account of it in the scientific journal, should think fit to take out a patent for it, observing due care always to conceal (nothing so easy) how he came to the knowledge of it! It is only by way of favour, as it were, that the rights of the first inventor himself are proposed to be saved!!! Were such a change as this ever to be made in the law, we should instantly have a perfect deluge of *re-invented* inventions. Old scientific books—the older the better—would grow into wondrous request; and great inventive geniuses become as plentiful as blackberries. Every dull, plodding knave, might by dint of a little rummaging merely, and a little keeping of his own counsel (as it is called), start forth in the character of a mechanical inventor and public benefactor of the first water. Hitherto the King, as representing the community at large, has been considered the ultimate heir to all property deserted or abandoned by its original owners; but Lord B.'s proposition is to transfer the heirship as regards all useful but unused inventions so situated, to whoever may choose to lay hold on them—to promote so far, nothing more nor less, than a *general scramble.*

We need not, we presume, detain our readers with any further remarks. We cannot permit ourselves to believe that so palpably inefficient, and yet so monstrously mischievous, a Bill as this can be in any danger of passing into a law. That a measure of such a description—displaying so little care for the rights of inventive genius, and so narrow an understanding of the interests of the public—so little sound principle, and so much practical silliness—should have Lord B. for its *real* author, quite staggers belief. It has nothing of his Lordship about it. except it may be his unfortunate rashness and precipitancy. When his Lordship undertook to prepare this Bill he promised to *apply his mind* to the subject. But applied his *mind* to it, he most assuredly has not. Lord Brougham's mind, as all the world knows, is a mind of the first order—equal to any thing; and had he but applied it in good earnest to the redress of the many undoubted hardships and oppressions of which inventors have to complain, he could never by any possibility have been the author of such a mockery of relief as the Bill before us.

A Bill, intituled, an Act to amend the Law touching Letters Patent for Inventions.

Whereas it is expedient to make certain additions to and alterations in the present Law touching Letters Patent granted to Authors of Inventions, as well for the better protecting of them in the rights intended to be secured by such Letters Patent, as for the more ample benefit of the public from the same; be it enacted, by the King's most excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, That any person who hath obtained or who shall hereafter obtain Letters Patent, for the sole vending or using or vending and using of any Invention, may, if he think fit, enter with the Clerk of the Patents, having first obtained the leave of his Majesty's Attorney General or Solicitor General, certified by his fiat and signature, a disclaimer of any part of his said specification, stating the reason for such disclaimer, or may, with such leave as aforesaid, enter a memorandum of any alteration in his said specification, not being such disclaimer or such alteration as shall extend the exclusive right granted by the said Letters Patent; and such disclaimer or memorandum of alteration, being filed by the said Clerk of the Patents and enrolled with the specification, shall be deemed and taken to be part of such specification, in all Courts whatever: Provided always, That any person may enter a caveat, in like manner as caveats are now used to be entered, against such disclaimer or alteration; which caveat being so entered shall give the party entering the same a right to have notice of the application being heard by the Attorney or Solicitor General: Pro-

vided also, That no such disclaimer or alteration shall be receivable in evidence in any action or suit pending at the time when such disclaimer or alteration was enrolled, but in every such action or suit the original specification alone shall be given in evidence, and deemed and taken to be the specification of the invention for which the Letters Patent have been or shall have been granted: Provided also, That it shall be lawful for the Attorney or Solicitor General before granting such fiat to require the party applying for the same to advertise his disclaimer or alteration in such manner as to such Attorney or Solicitor General shall seem right, and shall, if he so require such advertisement, certify in his fiat that the same has been duly made.

And be it enacted, That if in any suit or action it shall be proved that any person who shall have obtained Letters Patent for any invention or supposed invention was not the first inventor thereof, or of any part thereof, by reason of some other person or persons having, unknown to him, invented or used the same, or some part thereof, before the date of such Letters Patent, or that such person being or claiming to be the inventor, some other person had used such invention, or some part thereof, before the date of such Letters Patent, it shall and may be lawful for such patentee to petition his Majesty in Council for new Letters Patent, the matter of which petition shall be heard before the Judicial Committee of the Privy Council; and such Committee, upon examining the said matter, and being satisfied that such petitioner believed himself to be the original inventor, and being satisfied that such invention, or part thereof, had not been publicly and generally used before the date of such first Letters Patent, may report to his Majesty their opinion that the prayer of such petition ought to be complied with, whereupon his Majesty may, if he think fit, grant such prayer; and the said Letters Patent shall be available in law and equity to give to such petitioner the sole right of using, making and vending such invention as against all persons whatsoever, save and except such person or persons as did use the same invention before the date of the first Letters Patent, and those to whom he or they may have given leave to use the same, any law, usage, or custom to the contrary thereof notwithstanding: Provided that any person opposing such petition shall be entitled to be heard before the said Judicial Committee: Provided also, That any person, party to any former suit or action, touching such first Letters Patent shall be entitled to have notice of such petition before presenting the same.

And be it enacted, That if any action at law or any suit in equity shall be brought for an account in respect of any alleged infringement of such Letters Patent heretofore or hereafter granted, or any *scire facias* to repeal such Letters Patent, and if a verdict shall pass for the patentee, or if a final decree or decretal order shall be made for him, upon the merits of the suit, it shall be lawful for the Judge before whom such action shall be tried to certify on the Record, or the Judge who shall make such decree or order to give a certificate under his hand, that the validity of the patent came in question before him; which record or certificate being given in evidence in any other suit or action whatever touching such patent, if a verdict shall pass, or decree or decretal order be made, in favour of such patentee, he shall receive treble costs in such suit or action, to be taxed at three times the taxed costs, unless the Judge making such second or other decree or order, or trying such second or other action, shall certify that he ought not to have such treble costs.

And be it further enacted, That if any person who now hath or shall hereafter obtain any Letters Patent as aforesaid shall advertise in *The London Gazette* three times, and in three *London* papers, and three times in some country paper, published in the town where or near to which he carries on any manufacture of any thing made according to his specification, or near to or in which he resides, in case he carries on no such manufacture, or published in the county where he carries on such manufacture or where he lives, in case there shall not be any paper published in such town, that he intends to apply to his Majesty in Council for a prolongation of his term of sole using and vending his invention, and shall petition his Majesty in Council to that effect, it shall be lawful for any person to enter a caveat at the Council Office; and if his Majesty shall refer the consideration of such petition to the Judicial Committee of the Privy Council, and notice shall first be by him given to any person or persons who shall have entered such caveats, the petitioner shall be heard by his counsel and witnesses to prove his case, and the persons entering caveats shall likewise be heard by their counsel and witnesses; whereupon, and upon hearing and inquiring of the whole matter, the Judicial Committee may report to his Majesty that a further extension of the term in the said Letters Patent should be granted, not exceeding seven years; and his Majesty is hereby authorized and empowered, if he shall think fit, to grant new Letters Patent for the said invention for a term not exceeding seven years after the expiration of the first term, any law, custom or usage to the contrary in anywise notwithstanding; provided that no such extension shall be granted if the application by petition shall not be

made and prosecuted with effect before the expiration of the term originally granted in such Letters Patent.

And be it enacted, That in any action brought against any person for infringing any Letters Patent, the defendant on pleading thereto shall give to the Plaintiff, and in any *scire facias* to repeal such Letters Patent the plaintiff shall file with his declaration, a notice of any objections on which he means to rely at the trial of such action, and no objection shall be allowed to be made in behalf of such defendant or plaintiff respectively at such trial, unless he prove such notice of objection: Provided always, That it shall and may be lawful for any Judge at Chambers, on summons served by such defendant or plaintiff on such plaintiff or defendant respectively, to show cause why he should not be allowed to offer other objections whereof notice hath not been given as aforesaid, to give leave to offer such objections, on such terms as to such Judge shall seem fit.

And be it enacted, That in any action brought for infringing the right granted by any Letters Patent, in taxing the costs thereof, regard shall be had to the part of such case which has been proved at the trial, which shall be certified by the Judge before whom the same shall be had, and the costs of each part of the case shall be given according as either party has succeeded or failed therein, regard being had to the notice of objections, as well as the counts in the declaration, and without regard to the general result of the trial.

And be it enacted, That if any person shall write, paint or print, or mould, cast or carve, or engrave or stamp, upon any thing made or sold by him, for the sole making or selling of which he hath not or shall have obtained Letters Patent, the name of any other person who hath or shall have obtained Letters Patent for the sole making and vending of such thing, without leave in writing of such patentee; or if any person shall upon such thing, not having been purchased from the patentee or some person who purchased it from such patentee, or not having had the license or consent in writing of such patentee, write, paint, print, mould, cast, carve, engrave, stamp, or otherwise mark the word "Patent," the words "Letters Patent," or the words "By the King's Patent," or any words of the like kind, meaning or import, or shall imitate or counterfeit the stamp or mark or other device of the patentee, he shall for every such offence be liable to a penalty of fifty pounds, to be recovered by action of debt, bill, plaint or information, in any of his Majesty's Courts of Record at Westminster, one-half to his Majesty, his heirs and successors, and the other to any person who shall sue for the same: Provided always, That nothing herein contained shall be construed to extend to subject any person to any penalty in respect of the use of the name of any patentee, or in respect of stamping or in any way marking the word "Patent" upon any thing made, for the sole making or vending of which a patent before obtained shall have expired.

THE UNDULATING RAILWAY SYSTEM—THE TRUE QUESTION.

Sir,—Having taken a great interest in the controversy carried on for some time in your very valuable and instructive Magazine, relative to the undulating railway system, and conceiving that if Mr. Badnall can support in a satisfactory manner his views to any considerable extent, that it may introduce a principle in practical mechanics of greater value, and of more extensive utility, than its application to railway travelling, you will perhaps give me leave to suggest, that the true question seems to have been lost sight of by both parties. For though the mathematical investigations of those opposed to Mr. Badnall are clearly open to the objections ingeniously made by his very able supporters, in consequence of the former having confined their views within too narrow limits—and though this has given the undulationists (if I may coin a phrase) an opportunity to take advantage of the imperfect state in which the theory and laws of friction are, even at the present day, and of the want of sufficient data to calculate the variable force of steam locomotive-power—yet the result is still far from conclusive in favour of the new system. Friction cannot be elicited in these experiments without being accompanied with motion; and I would ask "Mentor," Are not the opposing forces equal when a train of carriages is moving at the rate of 30 miles the hour? For although both lines must have the advantage of an equal impulse at starting, yet the superiority or advantage had on one line will soon be dissipated and become equal to nothing. The true question is, Has locomotive-power any other power to overcome than that of friction when a heavy body is in motion? I believe, myself, it has the *vis inertia* constantly to oppose, although apparently the body may be in a state of uniform motion, and that it acts as an

opposing force in constant action; this is, in my opinion, the only way in which Mr. Badnall's experiments can be satisfactorily explained. However, the subject is yet open for further investigation.

I am, Sir, yours, &c.

X. Y. Z.

P. S.—I should like much to see Mr. Whitehead's reply to the observations made on his paper.

THE LIVERPOOL MECHANICS' INSTITUTION.

The foundation-stone of a new building for the purposes of this institution, was laid on Monday last, by Lord Brougham. It is estimated to cost not less than 10,000*l*., and when finished, will be one of the largest and most commodious structures of the kind in the kingdom. "A very few years ago," says a correspondent of the Architectural Magazine, "this institution, which was established in 1825, was in a sinking state, the funds in an extremely low condition, the number of members not more than 300, and the whole affair seemed likely to expire from their exhaustion. From this state it has been raised by the (originally) almost unaided energies of two successive honorary Secretaries, John Leyland and J. S. Radcliffe, Esqrs., who have spared no sacrifices of either time, labour, money, or influence. By their exertions, the public attention has been awakened to its advantages, influential individuals have lent a helping hand, the number of members has been augmented to about 1200, and a height of usefulness and prosperity has been attained, equal, if not superior, to any similar institution in the country; and all this, too, in the face of the direct opposition of some and the lukewarmness of others, who seem to dread the diffusion of knowledge as they would the plague." Lord Brougham, on laying the foundation-stone, addressed the assembled multitude in a very eloquent speech on the advantages of such institutions. One passage of it was particularly cheered.—"Nothing," said his Lordship, "can exceed the importance of the pursuit in which we are now engaged. It is to diffuse the blessings of knowledge, and to extend the means of instruction in the most useful arts, to by far the most useful members of this great community. (Cheers.) The establishment of a Mechanics' Institution in Liverpool, as elsewhere, is one of the most important eras in the history of this place—to lay the foundation from which may be expected the greatest improvements in the arts and the sciences themselves, and the happiest results from the diffusion of the most important knowledge among the people. (Cheers.) One thing only need be remarked, to illustrate the truth of what I have said, and it is this—during the last hour and a half I have travelled from Manchester to Liverpool, the only thought that presented itself at every step of the way, and indeed about the only subject which the immense velocity of our motion left one time to think about, was to whom and to what do we owe that extraordinary power, that mighty revolution of man's position on the globe, in their distances from and yet their intercourse with each other, so that Manchester is, as if by magic, brought within one-fifth of the distance it was ten years ago, and within one-tenth part of what it was a century before. (Loud cheers.) What is it that has made this extraordinary revolution, which has given to man the wings of the dove, and which enables him to perform his various public and private duties, and to participate in the pleasures, the amusements, and the enjoyments of life, a dozen times in the course of a single day, and at distances so far asunder as would have taken him in former times a week to accomplish?—What is it that makes the distance between Manchester and Liverpool seem as nothing, and which will soon make the distance between Liverpool and Birmingham, and Birmingham and London, take little more than the short space of ten hours to travel?—What is that which annihilates the space between different communities of men, and walking on the waves themselves "like a thing of life," brings countries buried in the heart of America in proximity with the coasts of that mighty continent, and civilizes nations of savages by bringing them in close and regular intercourse with nations of civilized men? Why it is to steam, which, generated by the power of nature, has been subjected to the uses of man, and made as docile, and a thousand times more powerful, than any domestic animal, instead of being a source of terror and dismay by its explosion. (Loud cheers.) And who subjected it to the use of man? A common working mechanic—James Watt, whose name ought to live, not merely in the history of his country, but of mankind. This common working mechanic, although he sprung from and was one of the people, possessed good conduct, genius, virtue, invention, and knowledge, which a man may acquire, if he chooses, whether he springs from a peasant or a duke; and to this man, the working mechanic of Greenock, is the world indebted for the mighty discovery of the gigantic power of steam. Now, there is not one mechanic who shall be taught at this institution, the foundation-stone of which has just been laid, that may not expect, in after times, to add to the discoveries of Watt, to extend the powers of his species, to increase

the resources of his country, and to benefit all mankind by the application of his knowledge to the greatest, the most useful of all pursuits in which mankind can be engaged —I mean, his triumph over the inert powers and forces of matter. (Loud cheering.) Having, for the first time, travelled on the railway, I could not see what I have seen this day without attempting to give expressions to the emotions which arose in my mind whilst surveying the triumph of human art, as displayed in that splendid specimen of mechanical ingenuity." (Cheers.)

At a public dinner afterwards given to his Lordship, he reverted once more to the subject of Mechanics' Institutions, and is reported to have made use of the following words:—"Mechanics' Institutions had spread in ten or twelve years prodigiously over the country; but ten or twelve years ago was not to be taken as the time when those useful institutions originated—the Institution in London was then established by Dr. Birkbeck, but twenty-two years ago the same distinguished character established the first Mechanics' Institution at Glasgow, and where he first gave scientific lectures to the humble artisans. (Cheers.) Some had doubted whether Dr. Birkbeck first *started* the Institution in London, *but of that there could be no doubt*, although he had many coadjutors to assist in preparing the plan of the Institution. It was, therefore, only taking a leaf out of the Doctor's book to establish other institutions of the same character, and to commence delivering lectures to the people. He (Lord Brougham) was ready to assist at meetings of such institutions, but he considered that the great merit of the Founder could not be eclipsed by any thing he could do, and ought not to be erased from the public mind."

What a pity that his Lordship should have marred so fair an exhibition of his intellectual powers, by statements so discreditable to his sense of moral rectitude as these! His Lordship knows well, for we have many times proved the facts upon him, past all denial, which we now once more repeat, that Dr. Birkbeck did *not* start the Institution in London —that for any thing done by Dr. B., there would never have been a Mechanics' Institution, either in the metropolis or any other part of England: that from the time of Dr. Birkbeck's leaving Glasgow, to the time of his following in the train of those who *did* start the London Institution, he never took one step to establish any where institutions for the scientific instruction of the working classes; and that even at Glasgow, he was but a hired lecturer in the institution alluded to, which was founded not by Dr. B., but by the much more eminent public benefactor, after whom it has been so appropriately named, the *Andersonian* Institution.

CALCULATING MACHINERY.

Sir,—I have been rather disappointed at not yet seeing any answer to what appeared to me the very reasonable questions of "P. S. C.," p. 119, respecting the Calculating Machines said to be invented by two individuals, and noticed in your very useful Magazine. Are we to conclude they would not stand the test of such inquiries? I confess I see no other sufficient reason for the silence preserved by the inventors.

Notwithstanding all that has been written respecting Calculating Machinery, comparatively but few persons seem to have a correct notion of its uses or its great importance; the majority appear to imagine it is some kind of instrument designed to stand upon a counting-house desk, by the assistance of which the junior clerk may cast up his accounts and learn the last new song at the same time, and with due gravity they question the economy of inventing and constructing a machine for such a purpose. They reason and conclude correctly and consistently with the quantum of knowledge they possess, and who can do more?

But although the utility of applying a machine to any purpose to which human labour can be applied with better effect and less cost, must be at once admitted, still the machine itself may be highly useful when applied to other purposes. It is thus with Calculating Machines. All I have ever heard of are worse than useless when applied to the calculations required in ordinary commercial transactions. But a machine which would make a series of calculations and print the results without the possibility of error, which would calculate and print tables for all the purposes for which science requires their assistance with a perfection of accuracy, which could not be doubted except by those whose ignorance deprived them of all right to form an opinion, would do more for the advancement of human knowledge than the steam-engine, with all its million uses, has done for the civilisation and happiness of mankind. This is a fact well known to persons the best able to judge correctly of the matter.

Now, it has been confidently stated, and no attempt has been made to con-

tradict the statement—that a machine of this kind has been invented and partly made; but that for some reasons which few persons know, and none will acknowledge, it has been laid aside and left to rust and go to ruin for nearly three years! Does this arise from personal feelings towards the inventor? or from mere apathy on the part of those who ought to see it finished for the benefit of the nation which has expended considerable sums upon it? Or have they arrived at the comfortable conclusion, that as science has done without such assistance for so long a time, she may do without it to the end of the chapter?

Yours, &c.
S. Y.

June 16, 1835.

P.S.—The best thing Mr. Pearson, p. 300, can do, is to publish as full a description as possible of *one* of his inventions, as he may rest satisfied and certain that if *it* will do what he supposes, the others will be immediately purchased at any price. Any one of them would make a man's fortune.—S. Y.

PATENT PADDLE-WHEEL CASE.

VICE-CHANCELLOR'S COURT, JULY 21.

Morgan and Lucena v. Seawards.

The plaintiffs, who are proprietors of the paddle-wheel patented by Mr. Elijah Galloway in 1829, and commonly known by the name of Morgan's wheel, some time ago obtained an *ex-parte* injunction to restrain the defendants, Messrs. Seawards, of the Canal Iron Works, Poplar, from completing a contract entered into by them with the Levant Steam-Vessel Company to supply the latter with paddle-wheels of a peculiar mechanical construction, which the plaintiffs allege to be merely a colourable imitation of theirs. The defendants had moved to have this injunction dissolved; and, after nearly three days' argument before the Vice-Chancellor, his Honour now gave judgment *in favour of the defendants.* As we propose to give next week a very full report of the case, with engravings of the wheel of the defendants, and such others of the wheels mentioned in the course of the pleadings as have not heretofore appeared in our pages (Morgan's was fully described in No. 598), we shall now content ourselves with stating very generally the grounds on which his Honour dissolved the injunction. He took it to be admitted on all hands, that the same effect was produced by both wheels, namely, that the paddles were made to enter into and emerge from the water at a more suitable angle than the paddles of the common wheel; but he was of opinion, that the arrangement adopted by the defendants for this purpose varied most importantly from that of the plaintiffs. In Morgan's wheel the shaft was necessarily divided in order to produce the vibratory (feathering?) action, and the wheel thereby much weakened; but in the wheel of the Messrs. Seawards, the necessity of such division was completely obviated. The shaft was not only entire, but the whole wheel unbroken and unencumbered. He considered, therefore, that the wheel of the defendants was not a colourable attempt to evade the plaintiffs' patent, but *prima facie* a decided improvement. This, however, was a proper question for a jury finally to determine. He should, therefore, direct the injunction to be dissolved, an action to be brought by the plaintiffs to try the question of infringement, and an account to be taken of the profits arising from the present, and any contracts effected in the mean time, to be rendered hereafter to the parties declared entitled at law.

In the course of the argument his Honour took occasion to observe, that a great deal of complaint had been unjustly raised against the patent laws. If, said his Honour, men of science would only condescend to exert a thousandth part of that thought in explaining, which they had exercised in maturing, the notion of an engine, great difficulty would be avoided, and the obloquy spared. It was, however, to be regretted they thought laboriously, but wrote carelessly.

ENGLISH AND AMERICAN LOCOMOTIVE ENGINES.

(From a Letter in the *American Railroad Journal*, signed "A Friend to American Manufactures.")

"In a visit to the workshop of Mr. M. W. Baldwin, of Philadelphia, from which I have just returned, I collected the following information:—Mr. B. has de-

livered from his workshop, within the last twelve months, ten locomotive steam-engines, has six now in his shop in a state of great forwardness, some of which are nearly completed, and has contracts on hand for about twenty engines, for the following roads, viz. the Columbia, Pa., State Road; the Trenton, the Newark, the Jamaica, the Troy and Saratoga, and the Utica and Schenectady roads. Under his present arrangements, he informed me that he gives employment to about 150 persons, and is able to complete an engine about every three weeks; and, to meet the increasing demand, is erecting workshops which will accommodate 300 hands.

"As regards the character of these engines, there are seven of them at work on the Pennsylvania State road, upon which they have also two English engines, from the workshop of their most celebrated maker, R. Stephenson.

"The engineer who has charge of the locomotive department on this road, informed me that the power of the American engines is about 35 per cent. greater than that of the English, and that the loss of time, and cost for repairs, is *altogether in favour of the American engines*: five hands, as he stated, having been sufficient to keep all the seven in order.

"For the gratification of such of your readers as are interested in railroads, I will refer to the principal points of difference between the English and American engine, and what I conceive to be the peculiar advantages of the American engine.

"It is well known, that the crank-shaft and the wheels of the locomotive engine, have been by far the most troublesome and expensive part of the machine to be kept in repair. By the improvements in Mr. B.'s engine, these difficulties have been obviated, as has been proved by experiment. Of the seven engines on the State road, and two on the Trenton road, some have been at work since the 1st of July last, and in no instance has a crank broken, or worked loose, or any of his improved wheels failed, or given trouble.

"It is here proper to observe, that the Pennsylvania road is almost a continued series of curves, ranging from 500 to 700 feet radius, and so severe is it upon the wheels of an engine, that one of the English engines, (the other having been out of repair most of the time,) has within two months used up or destroyed a part of the wheels of both engines, and is now using a set of Mr. Baldwin's wheels.

"The other improvements affect the force-pump, eccentrics, and reverse gear, all of which are so much simplified that the joints and working parts are not more than half as numerous as in the common English engine. The steam-pipes have all ground metallic joints, and no cement or soft solder is used in any of the joints of the engine.

"Another very important improvement has been added, by which the adhesion of the driving wheels may be increased at will, from 35 to 50 per cent. By this means, one of these engines, with only 6,487 lbs. on her driving wheels, as a fixed weight, has carried a gross weight of 80 tons up an inclination nearly two miles in length, of 35 feet per mile ascent, without any perceptible slipping of the wheels.

"The great object of the whole of these improvements has been to strengthen the weak points in the machine, and to simplify and reduce the number of its parts; and so fully has this object been accomplished, that this engine may justly be considered the most perfect of its kind now in use."*

NOTES AND NOTICES.

The Railroad System in America.—The *New Brunswick Fredonian* says:—"Railway stocks are all the go now-a-days among the speculators and capitalists. A few days since books were opened in Philadelphia for subscription to the stock of the Lancaster, Portsmouth, and Harrisburgh Railroad. In thirty-one minutes every share was taken, and a large number applied for beyond the ability of the Commissioners to supply. The stock of the New Jersey Railroad and Transportation Company is gradually advancing to its real value. It is eagerly sought after now at 126, and will, it is believed, not stop much, if any, short of 200*l*. The stock of the Camden and Amboy Railroad is also selling at an advance of something like 60 per cent.

Painted Binding.—Many beautiful subjects may be formed on the sides of books by the workman skilled in painting. The volume is prepared by being pastewashed, so as to present an uniform fawn colour, the designs slightly traced, and afterwards coloured according to the pattern, the colours being mixed to the proper shade with water. The shades must be tried on pieces of refuse leather, as, being

* For a further explanation of the construction of Mr. Baldwin's engines, see Mech. Mag., Vol. xxiii. p. 239.

spirit colours, when once laid on, no art can soften them down if too strong; and a peculiar lightness of touch will be necessary to produce effect. Portraits, &c., may also be executed in this manner; and many superb designs have at times been executed by the best binders of this country and France. M. Didot, bookseller, of Paris, presented a copy of the "Henriade," published by himself, to Louis XVIII., most elegantly ornamented in this style. It was executed by M. Bellier, bookbinder, of Tours, and presented on one side a miniature portrait of Henry IV., and on the other a similar one of Louis XVIII., both perfect likenesses. The greatest difficulty consisted in the portraits, which were first imprinted on paper, very moist, and immediately applied to the cover, on which they were impressed with a flat roller. When perfectly dry, they were coloured with all the art of which the binder was capable, and the other ornamental paintings executed by hand. This proceeding requires great care in the execution; and will be applicable to any design where the binding will justify the expense.—*Arnett's Bibliopegia.*

Power of the Screw.—There is a screw-dock in New York, at which a ship weighing 200 tons can be raised a height of two feet in thirty minutes by the power of only fifty men applied to the screws.

Prodigious Force of Earthquakes.—An English merchant ship, which was nearly four miles from the land (at the time of the late earthquake in Chili), and going seven knots, seemed in a moment to be arrested, and her bottom grated as on a hard sand. So perfect was the illusion, indeed, that the master was in the act of lowering his boats to save the crew, considering the vessel irrecoverably wrecked on a bank, when it was ascertained that there were no soundings even at ninety fathoms!—*Extract from a Private Letter in the Athenæum.*

Plate-Glass.—A French paper states, that the largest piece of plate glass ever manufactured has just been finished at St. Gobin. It is 175 French inches high by 125 wide. At the last Exhibition at the Louvre, the largest plate shown was 155 inches by 93.

Mr. Perkins' Boiler.—The *Franklin Journal* for last month contains a paper by Professor Bache of the University of Pennsylvania, in which he gives the details of a series of experiments made by him "on the efficacy of Perkins' Steam-Boilers." "The inference from these experiments," says the Professor, "is obviously, that so far from producing any important effect in promoting the generation of steam, the inner cylinders or circulars did not even effect a sensible increase in the quantity of water vaporized in a given time, and with a given quantity of fuel."

Thermometers.—Professor Johnson exhibited some alcohol and mercurial thermometers constructed by him of large size and admitting of graduation to hundredths and even two hundredths of a degree Fahr. He showed a curious fact not noticed in descriptions of the thermometer, namely, that the first effect of heat on one of these instruments is to cause a fall in the liquid, and the reverse on reducing the temperature—effects produced as was explained by the expansion and contraction of the glass.—*Monthly Meeting Franklin Institute.*

Mr. Gurney's Case.—We have good authority for stating, that the Chancellor of the Exchequer has refused the consent of the Crown to the grant of 16,000*l.* proposed, by a Committee of the House of Commons, to be given to Mr. Gurney as the alleged inventor of steam-carriages on common roads. The Chancellor of the Exchequer's conduct in this affair does him great credit.

Tidal Experiment.—A stone plunged into a pool of still water occasions a series of waves to advance along the surface, though the water itself is not carried forward, but only rises into heights, and sinks into hollows, each portion of the surface being elevated and depressed in its turn. Another stone of the same size thrown into the water near the first will occasion a similar set of undulations. Then, if an equal and similar wave from each stone arrive at the same spot at the same time, so that the elevation of the one exactly coincides with the elevation of the other, their united effect will produce a wave twice the size of either; but if one wave precede the other by exactly half an undulation, the elevation of the one will coincide with the hollow of the other, and the hollow of the one with the elevation of the other, and the waves will so entirely obliterate one another, that the surface of the water will remain smooth and level. It will be found that, according to this principle, when still water is disturbed by the fall of two equal stones, that there are certain lines on its surface of a hyperbolic form, where the water is smooth in consequence of the waves obliterating each other; and that the elevation of the water in the adjacent parts corresponds to both the waves united. Now, in the spring and neap tides, arising from the combination of the single soli-lunar waves, the spring-tide is the joint result of the combination when they coincide in time and place; and the neap-tide happens when they succeed each other by half an interval, so as to leave only the effect of this difference sensible. It is therefore evident, that if the solar and lunar tides were of the same height there would be no difference, consequently no neap-tides, and the spring-tides twice as high as either separately. In the port of Botsha, in Tonquin, where the tides arrive by two channels of lengths corresponding to half an interval, there is neither high nor low water, on account of the interference of waves.—*Mrs. Somerville.*

Evaporation of Plants.—Forests cool the air by shading the ground from the sun, and by evaporation from the boughs. Hales found that the leaves of a single plant of helianthus, three feet high, exposed nearly forty feet of surface; and if it be considered that the woody regions of the river Amazons, and the higher part of the Oroonoko, occupy an area of 260,000 square leagues, some idea may be formed of the torrents of vapour which arise from the leaves of forests all over the globe. However, the frigorific effects of their evaporation are counteracted in some measure by the perfect calm which reigns in the tropical wildernesses.—*Mrs. Somerville.*

Communications received from Fanqui—Mr. Thomas Gray—E. H.—A Looker-on—Mr. Dickinson—G. J. H.

Our Publisher will give One Shilling and Sixpence for copies of the Supplement to Vol. IX.

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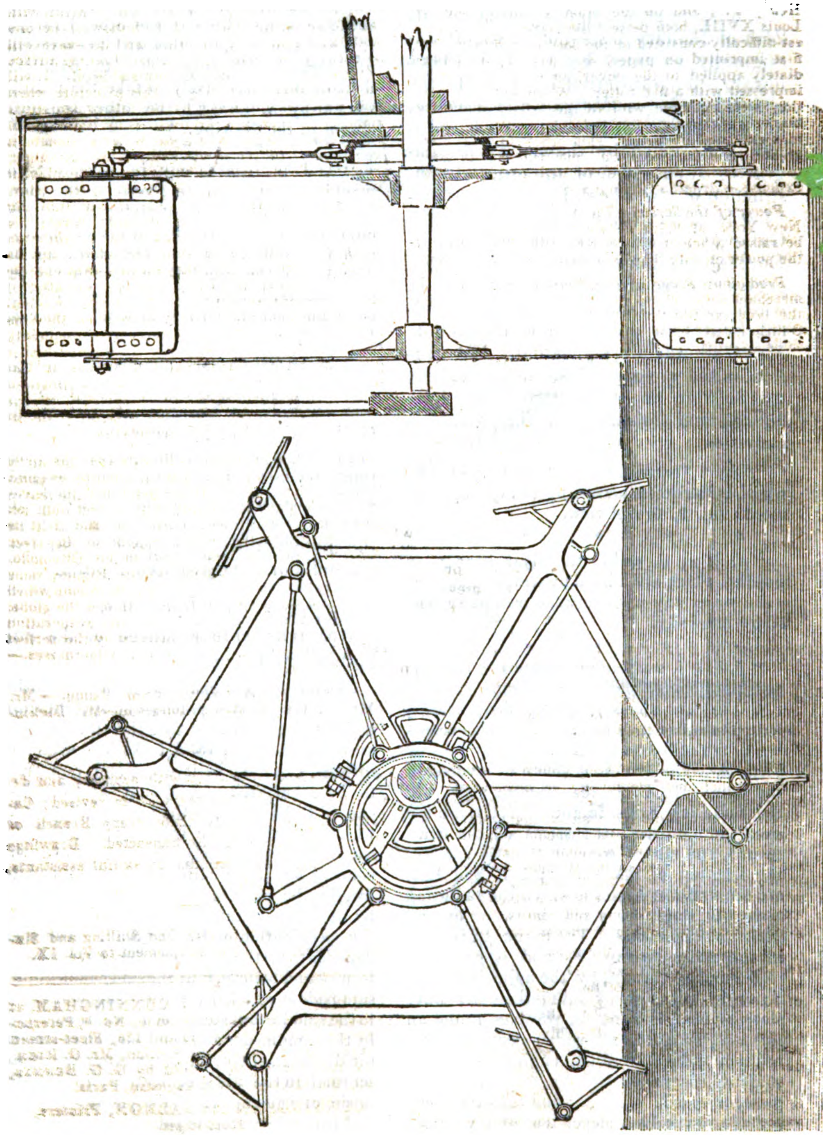


MESSRS. SEAWARDS' PADDLE-WHEEL.

PATENT PADDLE-WHEEL CASE.

VICE-CHANCELLOR'S COURT,
July 10, 20, and 21, 1835.

Morgan and Lucena v. Seawards.

(Further Report.)

The paddle-wheel which forms the subject of the charge of piracy in this case was fully described in our journal of the 24th of January last—not only as it was originally patented by Mr. Elijah Galloway, who transferred his right to the plaintiffs, Messrs. Morgan and Lucena, but as it has been since improved and is now constructed by them. As the engraving then given of the original construction of the wheel, however, is somewhat indistinct (though copied from Mr. Galloway's own work on the Steam-Engine), we have given on the opposite page a side-section and an end-view of it, which are exact copies of the two principal figures in the drawing attached to Mr. Galloway's specification. We subjoin, also, a copy of so much of the specification as is descriptive of these figures, and the extent of the patentee's claim :—

"Fig. 1, represents a section of a paddle-wheel constructed according to my improvement; fig. 2, an end view.

* * * * *

"*a*, *b*, *c*, *d*, and *e*, the float boards, or paddles, which are affixed by straps and screw bolts, or by any other suitable means, to bent stems marked *f*.

* * * * *

"*g*, *h*, *i*, *j*, and *k*, are connecting rods attached at one of their ends by pins or bolts *r*, to the bent stems *f*, of the float boards, &c.; the other ends of all these rods excepting *g*, are attached to the disc A, by pins or bolts, S. The disc A, is made to revolve on the crank B; C, is the framing; D, are the radiating arms of the wheel; *t*, are the axes (which carry the stems of the float-boards, and which connect the two sides of the framing of the wheel); E 1, and E 2, are the naves or bosses to which the radiating arms are fixed, by screw bolts, or by any other suitable means. The crank B, is fixed in the outer bearing F, and is prevented from turning therein, by the adjusting screw X, or by keys, or by both; the outer nave plate, or boss, E 2, fig. 2, revolves round an axis; G, is the shaft which communicates rotatory motion from the engine, and which shaft G, is made fast to the inner nave plate, or boss E 1, fig. 2; and thus the wheel is made to revolve independent of the crank, the part *x*, being merely a bearing, and not a fixture. Now, it will be evident from the above description, that on turning the wheel in the direction of the arrow, fig. 1, the paddle or float-board *d*, will be carried forward to nearly the position of *e*. It will be seen, that the lever *g*, is made fast to the disc A, and does not turn on a pin, as is the case with the others; consequently, the advancing of *d*, to the position of *e*, will turn the disc A, and with it the other levers, *h*, *i*, *j*, and *k*, which, together with the revolving of the wheel, will cause each of the paddles or float-boards successively to take the position shown by *a*, and all the other positions shown in the drawing.

* * * * *

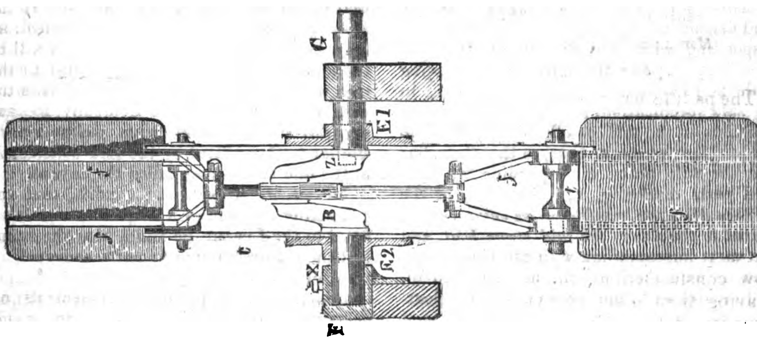
"And as regards my improvements on machinery for propelling vessels, the mode hereinbefore described, of giving the *required* angle to the paddles, by means of the rods *g*, *h*, *i*, *j*, and *k*, and *bent stems marked f*, the *disc* A, and the *crank* B, and such my improvements, being, to the best of my knowledge and belief, *entirely new* and *never before used, &c.*"

The paddle-wheel constructed by the defendants, Messrs. Seawards, and which was charged to be an imitation of Mr. Galloway's wheel, is represented in the engravings on our front page, the positions in which it is shown being precisely analogous to that in which the plaintiffs' wheel is exhibited, that the reader may the more readily perceive how far they resemble or differ from each other.

For the Injunction,

Affidavits were produced of the purport following:—

Messrs. Morgan and Lucena, after reciting Mr. E. Galloway's patent and specification, and the history of their title thereto, Say, that on the 10th April, 1835, these deponents were informed, as they believe the fact and truth to be, that the defendants had fitted or caused to be fitted, to the Levant steam-boat, which, as they were informed, and believe, was then immediately about to leave this country for the Mediterranean, two paddle-wheels, the paddles whereof were acted upon by using or imitating the mode described in the specification of E. Galloway. And these deponents further say, that they have been informed and believe, that the said paddles of the said paddle-wheel, fitted by the said defendants to the said Levant steam-boat, were acted upon by the same means and combination of mechanical instruments or implements or parts, as are set forth in the said specification; and that the mode of causing the said paddles to enter and leave the water, is substantially the same as the mode set forth in the said specification,


G
E1
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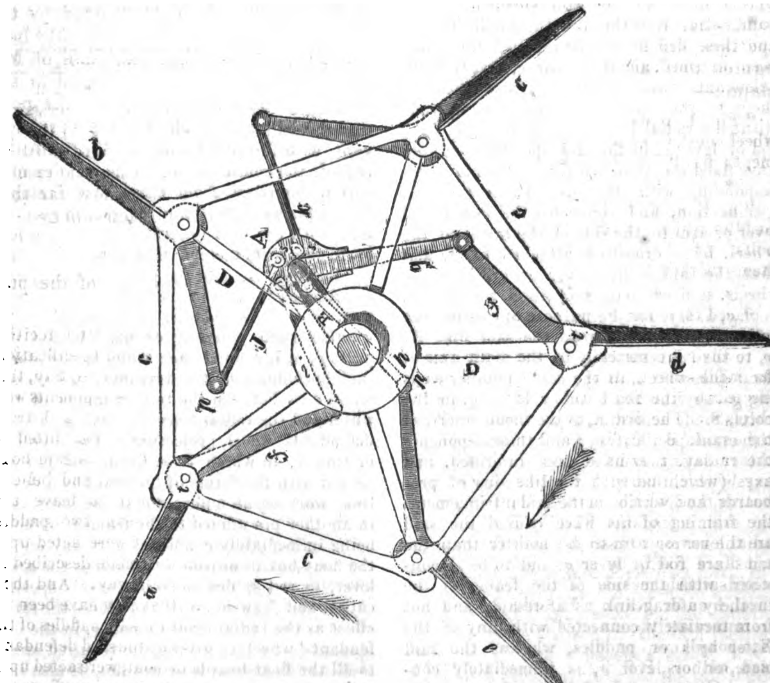
A
D
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but that, in order, as these deponents believe, to prevent the said infringement of these deponents' patent right from being detected, the said defendants have caused the collar corresponding with the disc A, in the said specification, and the parts corresponding with the parts marked *f*, *g*, *h*, *i*, *j*, and *k*, in the said specification, to be placed in altered positions on the said paddle-wheels, fitted to the said Levant steam-boat, so that the collar and the said parts, corresponding with the said parts marked *g*, *k*, *i*, *j*, and *k*, in the said specification, revolve on *an enlarged axis affixed to* the *side of the said steam-boat*, and the parts corresponding with the bent stems *f*, in the said specification, are attached to, and revolve with, the inner ends of the float-boards or paddles; whereas such disc A, and the parts *g*, *h*. *i*, *j*, and *k*, according to the said specification, would be placed on an axis between the frames of the said paddle-wheels; and the bent stems *f*, in the said specification, would be attached towards both the ends of the float-boards or paddles, and revolve with them; and in the said paddle-wheels fitted to the said steam-boat, the paddle-shaft runs through the paddle-wheel; and these deponents further say, they have been informed, and they believe, that the said defendants have, in the wheels so fitted by them to the said vessel, the Levant, substituted a radial lever or arm for the fixed rod or lever *g*, in the said specification, and have fixed the same in the said collar corresponding with the disc A, in the said specification, and connected the said radial lever or arm to the side of the frame of the wheel, by a drag-link attached to it, and that the said radial lever or arm, in the wheels, so fitted to the said vessel, the Levant, is placed there for the purpose of causing the collar corresponding with the said disc A, to revolve eccentrically to the main axis of the paddle-wheel, in the same manner as is effected by the fixed rod or lever *g*, in the wheels made according to the mode described in the said specification; and these deponents further say, they have been informed, and they believe, that with the like view of preventing the detection of the said infringement, the said defendants have caused the said radial lever or arm to be shorter than the said fixed rod or lever *g*, and to be so connected with the side of the frame of the wheel, by a drag-link as aforesaid, and not be immediately connected with any of the float-boards or paddles, whereas the said fixed rod or lever *g*, is immediately connected with one of the float-boards or paddles, in wheels constructed according to the mode described in the said specification; and these deponents have been informed, and believe, that the said steam-boat, called the Levant, has left this country since the said 10th day of April, 1835, on her voyage to the Mediterranean; and these deponents further say, that on the 4th day of this inst. month of May, and not before, they were informed, as they believe the fact and truth to be, that the said defendants had entered into a contract with a company called the Mediterranean and Levant Steam-Packet Company, to supply the said company with paddle-wheels similar to those fitted by the said defendants to the said steam-boat called the Levant.

Mr. M. J. Brunel, C.E., saith, that on examining the paddles of the paddle-wheels so fitted to the Levant, he found that the same had the required action or angle conveyed or transmitted to them by the same means and combination of mechanical instruments or improvements or parts as are set forth in the specification of E. Galloway, and the drawings thereunto annexed; and that the mode of causing the paddles to enter and leave the water at the required angle is substantially the same as that described in the said specification and drawings; and that the mode in each is destined to perform the same functions, and is used as the means necessary for giving to the paddles the required *action* or any angle that may be considered most suitable for the object obviously contemplated and specified in the said specification and drawings. And this deponent further saith, that the said paddle-wheels fitted to the Levant, as before-mentioned, differed so far as regards the combination, in the said specification described, from those manufactured by the plaintiff, William Morgan, in accordance with the said specification, in the following respects merely, that is to say, a ring or coupling A, and the parts *g*, *k*, *i*, *j*, and *k*, attached thereto in the defendants' wheel, turn on an enlarged axis to the ship's side; whereas such coupling or disc A, and the parts *g*, *h*, *i*, *j*, and *k*, according to the aforesaid specification and drawings, are placed on an axis between the two framings of the wheel and the radial lever or arm; *g*, in the defendants' wheel, projects from the coupling or ring A, in which it is fixed, and is connected with the frame of the wheel by a drag-link (working on a pin-joint in the lever, and in another pin affixed to the frame), without being immediately connected with any one of the float-boards or paddles; whereas the arm, lever, or rod *g*, described in the said specification and drawing, which produces the same effect as the radial lever or arm *g*, in the defendants' wheel, in giving the required angle to all the float-boards or paddles, is also immediately connected with one of the float-boards or paddles in the plaintiff, William Morgan's wheels. And this deponent further saith, it is indispensable in wheels made according to the said specification, as well as in those made by the defendants in imitation

thereof, that the excentric axis should be fixed; and this deponent further saith, that in those fitted to the Levant the excentric axis was fixed to the vessel's side, whereas in the said specification the excentric axis is described as fixed to the projecting framing of the paddle-box. And this deponent further saith, that the said enlarged axis or excentric so affixed to the ship's side in the Levant's wheels are the same in substance and effect as the cranked axis B in the said specification, both being employed for the purpose of causing the coupling or disc A, in its revolution, to turn eccentrically to the main shaft. And this deponent further saith, that in the said wheels fitted to the Levant the paddle-shaft runs through both the frames of the wheels, which is effected by the removal of the combined parts *f*, *g*, *h*, *i*, *j*, and *k*, A and B, from the interior of the wheels (where they are placed in conformity with the said specification) to the outside of the frames. And this deponent further saith, that the paddle-shaft in wheels made according to the mode described in the said specification cannot be carried through both frames, in consequence of the combined parts, *f*, *g*, *h*, *i*, *j*, and *k*, A and B being necessarily placed in the interior of such wheels, but that, in the judgment of this deponent, the requisite strength is in this case effectually obtained by cross-bracing or ties;* and, therefore, that no disadvantage has been found to arise in practice from the paddle-shaft not passing through the wheel.† And this deponent further saith, that the alterations in the framings and shafts of the paddle-wheel so fitted to the Levant, are not alterations in those parts which constitute the invention claimed by the said patent. And this deponent further saith, that a disadvantageous consequence results from the said defendants having made the paddle-shafts to extend or project through the wheels so fitted to the said steam-vessel, Levant; inasmuch as in the passage of the float-boards or paddles through the water, the desired action being imparted to them at one end only, and the resistance of the water being dispersed over the whole of each float-board or paddle immersed, a twisting strain is brought not only on the float-boards themselves, but likewise on their centres of motion *t*; and also extends to the several parts, instruments, or implements, by which the required angles are given to the said float-boards or paddles, such strain having a direct tendency forcibly to separate the said parts or instruments. And this deponent further saith, that another injurious consequence attendant on the said application by the said defendants of the mode for giving to the paddles the required action, is, that the pins or bolts *s r*, by which the triangular levers *f* are coupled with the rods *h*, *i*, *j*, and *k*, are of necessity of considerable length, and, being only held at one end, are very insecure. And this deponent further saith, that, in his judgment, the said defendants have in the wheels so fitted by them to the said steam-vessel, the Levant, injudiciously departed from the arrangement of the means described in the said specification for imparting the desired action to the floats; and that the combination as applied by the said defendants is, although substantially the same as that described in the said specification, less effective than when applied in accordance with the said specification, as in such latter case the float-boards are acted upon in their centre, and the strain is thus allowed to bear with equal force on every part of the paddles or floats, which renders the mode as set forth in the said specification at once more effective and secure than the imitation of it practised, as aforesaid, by the said defendants. And this deponent further saith, that by the defendants' substitution, in the wheels fitted to the said vessel, the Levant, of the radial lever or arm *g*, with a drag-link coupling it to the frame for the arm, lever, or rod *g*, described in the said specification, three additional pin-joints and one guide-rod, besides the drag-link, are all rendered necessary to perform the same functions as those performed by the mode described in the said specification; and that the said deviation requiring, as it does, the said additional means to produce the same effect, is disadvantageous. And this deponent further saith, that, from the circumstances hereinbefore set forth, such change of position in the eccentric wheels so fitted to the Levant steamer, of the combined parts or mode claimed by the said specification, is, in this deponent's belief, only a colourable expedient to evade the said patent, as in other respects the character of the combination of the various parts is the same as that described in the said specification, that is to say, the bent stems *f* are attached to the connecting-rods *h*, *i*, *j*, and *k*, by the pins *r*,

* The plaintiffs' wheel, as originally constructed, however, contained no such "cross-bracing or ties." See the engravings, and also the subsequent evidence of Tunnicliffe and Nugent. If the reader will keep this in mind it may help to account for the extraordinary difference of opinion between the two sets of witnesses on the point of strength. The plaintiffs' witnesses speak invariably of Morgan's wheel as it is *now* constructed; the defendants' of the wheel as it should be constructed *according to the specification.*—Ed. M. M.

† From the following extract from the evidence given by Admiral Sir Pulteney Malcolm before the Select Committee for Steam Navigation to India, it will be seen that Mr. Brunel has been probably misinformed on this point:—

"Was there not some accident with the Firebrand vessel?—Yes, I think there was.

"Was it to the *axle?*—I do not recollect; but I *think it was the axle.*"

the connecting-rods are attached to the coupling or ring A by the pins S, as set forth in the said specification; the connecting-rod *g* is permanently fixed to the coupling or ring A, which coupling or ring revolves eccentrically to the main shaft, the coupling or ring A being in substance and effect the same as the disc or coupling A described in the said specification; and the connecting rod *g* is coupled by a link to the framing of the wheel, and therefore draws round the coupling or ring A; consequently, the rods *h*, *i*, *j*, and *k*, and the rod or lever *g*, owing to their manner of combination, perform equally in both cases the same functions, and are the necessary means for giving to the paddles the required action, or any angle that may be considered most suitable for them, to enter and leave the water; and which effect is alike produced both in wheels made according to the said specification and in those fitted to the Levant, in consequence of the connecting-rods *h*, *i*, *j*, and *k*, being moveable on their pins *r* and *s*, with reference to their attachment to the bent stems *f*, and the coupling or disc A; and of the connecting-rod *g* being a fixture to the coupling or disc A, and such coupling or disc revolving on an axis at a distance from or eccentric to the shaft of the paddle-wheel.

Mr. Alexander Park, C. E. and *Mr. William Carpmael*, C.E., Say, for reasons similar to those given by Mr. Brunel, that they consider the mode of construction adopted by the defendants to be merely a "colourable" attempt to evade the plaintiff's patent, and in so far as it is a departure from that laid down in E. Galloway's specification, highly injudicious.

Mr. John Kingston, Engineer and Master Millwright of his Majesty's Dock Yard, Woolwich, Saith, that he has witnessed the progress of the application of the plaintiff, William Morgan's patented wheels, to several of his Majesty's steam-vessels; from the first set of such wheels, which were fitted at the close of the year, one thousand eight hundred and twenty-nine up to the present time; and this deponent further saith, that every such set of wheels so applied presented the same character of combination, and has never been deviated from; and this deponent further saith, that in every instance the float-boards or paddles of such paddle-wheels have been each fixed to a bent stem vibrating on an axis, and have been made to assume the required angles by means of rods connected by pin joints to the bent stem-heads at one of their ends, and connected at their other ends (with one exception in each wheel) to a disc or collar working on an eccentric axis in the centre of the wheel, the rod excepted, being made a fixture in the disc or collar, in order that by its connexion to the bent stem it should cause the disc or collar to revolve with the main frame of the wheel, and thus, by dragging or forcing the disc or collar round, cause the pin-jointed rods to give the angles required to their respective floats; and this deponent further saith, that in the wheels universally known as the said plaintiff, William Morgan's wheels, the eccentric axis has been always formed by means of a crank, whose shaft or gudgeon has been a fixture in or on the outer beam of the paddle-box frame, and whose throw or pin has formed the axis. And this deponent further saith, that such combination of parts to produce the desired angles for the float-boards or paddles, has never been departed from in any of the wheels fitted by the plaintiff, William Morgan, to vessels for his Majesty's service, nor has any addition been made thereto, or been rendered necessary to give the required angles to the float-boards or paddles. And this deponent saith, that, according to the best of his knowledge and belief, the said combination so applied by the said plaintiff, William Morgan, was neither known nor used in this kingdom previously to its introduction by the said plaintiff in the year 1829. And this deponent further saith, that in the discharge of his official duties he has from time to time collected from such of the commanders of his Majesty's steamers as have used the wheels made by the said plaintiff, William Morgan, most favourable accounts of their performance, especially during tempestuous and adverse weather. And this deponent further saith, he has found such accounts to be fully borne out by the opinions of the engineers who have worked the engines to which such wheels have been fixed. And this deponent further saith, that the system of trussing adopted by the said plaintiff, William Morgan, in the wheels of his construction, fully compensates for the want of the shaft being carried through from side frame to side frame, which this deponent is enabled to say from having officially examined such wheels on their return from service to Woolwich Dock Yard, where the Admiralty steamers are fitted and undergo all essential refits; and this deponent has found the frames and their points of connection to be invariably sound. And this deponent further saith, that owing to the nearly if not perfectly total absence of vibration, resulting from the quiet action of such wheels, he considers that the greater duration of the vessels and, in a degree, the engines, to which they are fitted, must and does ensue.

Mr. Robert Grundy, Pilot of his Majesty's Dock Yard, Woolwich, Saith, that he has for very many years past been accustomed to steam-vessels. And this deponent further saith, that he piloted his Majesty's steam-vessel Confiance on her trips shortly after the

paddle-wheels had been fitted thereto by the said plaintiff, William Morgan (and which wheels are known or designated as Morgan's paddle-wheels), at the latter end of the year 1829, and the spring of 1830. And this deponent further saith, he perfectly recollects the improvement in speed to the said steam-vessel, and also the reduction in vibration and back surge, all resulting from the wheels so fitted by the said plaintiff, William Morgan. And this deponent further saith, he has been to sea in the Confiance when so fitted in very heavy weather, and found the said wheels a great improvement in navigation upon wheels fitted with the ordinary paddles. And this deponent further saith, he has been to sea successively in many other steam-vessels in his Majesty's service, which have been fitted with paddle-wheels by the said plaintiff, William Morgan, and known as aforesaid as Morgan's paddle-wheels; and this deponent has found the favourable opinion which he had formed on experiencing their good effect in his Majesty's steam-vessel Confiance, borne out and increased thereby. And this deponent further saith, that having had constant opportunities of comparing the said eccentric wheels with other wheels on new systems, as well as those on the old or common system of paddle-wheels, he has invariably found that the eccentric wheels so fitted by the said plaintiff, William Morgan, produce in the steam-vessels, to which the same are fitted, a greater degree of speed than that which any other wheels produce, and afford the comfort of freeing the vessel from the vibrations to which the ordinary wheels subject it; and that these advantages, which exist in smooth water, are comparatively much greater in rough and boisterous weather; and that, in fact, this deponent not only considers Morgan's wheels to be a GRAND improvement over the old wheel used in steam navigation, but to be unrivalled by any other he has ever seen or heard of, and from the experience he has had of the performance of Morgan's wheels in very bad weather, he has not the least doubt of their stability.

Mr. Robert Pickering, Managing Engineer to Mr. Morgan, Saith, that he examined the wheels fitted to the Levant by the defendants, and found them to be as direct an imitation of the mode described in Mr. E. Galloway's specification, "as it was well possible to make." And that, except in so far as respects the charge of position, the means adopted by the defendants "are substantially and in effect the same as the means claimed in the said specification as the mode of giving the angles required to the float-boards or paddles."

Mr. Charles Dick, Operative Engineer, and "leading hand in the service of the plaintiff, William Morgan," Saith, that as an operative mechanic accustomed to navigation, he is of opinion that the combination as described in the said specification and drawings, and used by the said plaintiff, William Morgan, is far more efficient and stable than the arrangement combined in the wheels fitted to the steam-vessel Levant; for in the latter, the arms which bear the axes of the float-boards are of necessity left unsupported at the point which receives and has to bear the entire strain, and the float-boards receive their angular direction from their inner end alone: whereas, in the patented combination the arm-ends, which have to bear all the strain, are well bound up together by a series of supports or stays in the direct line of the strain, and the requisite action of the float-boards or paddles is produced by the leverage acting on the centre of resistance. And this deponent further saith, that as a practical mechanic he considers that the wheels fitted as aforesaid to the steam-vessel Levant are a direct piracy, and that the colourable deviations are bad departures from the arrangement of the combination described in the said specification and drawings. And this deponent further saith, that he has had much experience of steam navigation, and that in his judgment the application of wheels similar to the said wheels fitted to the said steam-vessel Levant, will bring discredit on the character of paddle-wheels manufactured by the said plaintiff, William Morgan, in accordance with the said specification and drawings thereunto annexed, inasmuch as the wheels so constructed for, and fitted to, the said steam-vessel Levant, are exposed to a great variety of twisting strains and cross-bends on the several bearings or points of motion, from which the wheels, manufactured by the said plaintiff, William Morgan, in conformity with the mode set forth in the said specification, are totally exempt.

For Dissolving the Injunction,

Affidavits were produced of the purport following:—

Mr. John Seaward, Engineer, Saith, "that he has been actively employed for several years last past, and is well acquainted with and has been and now is extensively engaged in the manufacture of machinery of various descriptions, and particularly steam-engines and machinery for propelling vessels, and this deponent denies, that the paddle-wheel made by this deponent, mentioned in the injunction granted upon the exparte application of the said plaintiffs, is an infringement of or a colourable expedient to evade, or colourable evasion or attempt to evade, the patent of Elijah Galloway, claimed by the said plaintiffs as alleged by the said

plaintiffs. Deponent saith, that previous to and since the year 1813, it has been the object and practice of engineers and others concerned in machinery for propelling vessels, to cause the float-boards of paddle-wheels to enter and leave the water edge-ways, as being a position supposed to be more advantageous than that of the float-boards in the common and ordinary paddle-wheel. And this deponent saith, that previous to the year 1829, several patents had been obtained for such description of wheels and various mechanical contrivances by which such position of the float boards was acquired, were well known to engineers and working mechanics in this country; and this deponent verily believes, that in the alleged invention or patent and specification of the said Elijah Galloway, as to the said paddle-wheel therein specified and mentioned and claimed by the said plaintiffs, there was no novelty; and deponent verily believes the patent is void, and cannot be supported for the said paddle-wheel. Deponent saith, that in the month of May, 1833, he made a voyage from Havre to Rouen on board the steam-vessel Louis Philippe, which said vessel had a pair of paddle-wheels so constructed as to cause the float-boards to enter and leave the water edge-ways, and agreeable to the manner supposed to be more advantageous as aforesaid. Deponent saith, he carefully examined the said wheels, and although this deponent did not discover any novelty in the various parts of the said wheel, this deponent considered the arrangement, by which the several parts were brought into action, was well contrived, and the effect produced was the same in principle as various paddle-wheels manufactured in England since the year 1813. And this deponent, during the said voyage, which lasted about ten hours, took a sketch or drawing of the same, and deponent then understood that the said wheels had been for several years in use, and made by Monsieur Cavé of Paris. Deponent saith, upon his return to England he made, or caused to be made under his immediate direction, a model of the said wheels. Deponent saith, he considered that he could construct a paddle-wheel much more efficient for the purpose aforesaid than the one he had seen on board the steam-vessel Louis Philippe, and after consulting with his partners, it was determined so to do; and after much trouble and expense, deponent made, or caused to be made, the wheel in question and now complained of. (See engravings.) Saith, that on the construction, arrangement, or manufacture of the said last-mentioned wheel, or the said model, this deponent did not directly or indirectly advert to examine or in any manner refer to the paddle-wheel alleged to be the said Elijah Galloway's, and claimed by the said plaintiffs in this cause; and, on the contrary, the same was a construction and arrangement of his own under the circumstances, and as before-mentioned." And after reciting certain correspondence which took place between the said plaintiffs and defendants, respecting the alleged infringements, this deponent said further, "that in the early part of the month of May last, this deponent and his said partners entered into a contract with the Mediterranean and Levant Steam-packet Company, to supply within three months two pair of forty-horse power steam engines, to be applied to vessels for them, and now preparing, and also engaged with the said company to furnish them with and for the said engines two pair of paddle-wheels on the vibrating principle, similar to those supplied and fitted to the said steam-vessel called the Levant. Deponent saith, that he and his said partners are bound to supply the said engines and wheels to the said company within the time aforesaid, under a very heavy penalty. Deponent saith, he has reason to, and does verily, believe, that the said plaintiffs are well aware of the contract so entered into by this deponent and his said partners, and of the penalty to which they are liable if the said contract is not performed; and the said plaintiffs, in the opinion and belief of this deponent, made the present application to this honourable Court (concealing, as deponent humbly submits, the before-mentioned communications between deponent and the said plaintiff, William Morgan), for an exparte injunction with a view of preventing this deponent and his said partners from performing their said contract; and deponent understands that the said plaintiffs, or one of them, have lately entered into some contract with the said Mediterranean and Levant Steam-packet Company to supply and furnish them with paddle-wheels. Deponent saith, that since the granting of the injunction in this cause, he has made inquiry and been informed, and verily believes, that paddle-wheels, upon the precise plan and agreeable to the said specification of the said Elijah Galloway, had been manufactured in this country before the date of the said patent of the said Elijah Galloway, and now claimed by the plaintiffs as aforesaid. And deponent has also been informed and believes, that a model of a paddle-wheel similar and in every respect resembling the said paddle-wheel claimed by the said Elijah Galloway, and now by the said plaintiffs, as aforesaid, was publicly exhibited before the date of the said Elijah Galloway's said patent.

Mr. William Brunton, C. E., Saith, that he has, at the request of the defendants, attended to, and carefully examined the model of a paddle-wheel, with vibrating or moveable float-boards, as manufactured by them, and

as this deponent is informed, and believes, was fitted and applied to the steam-vessel called the Levant; and this deponent has carefully examined the said model, and is well acquainted with the mode of its operation; deponent saith, he has also carefully examined the office copy of the specification of the patent granted to Elijah Galloway, dated the 2nd day of July, 1829, for certain improvements in steam-engines, and in machinery for propelling vessels, and which improvements are applicable to other purposes, and also the drawings attached thereto, and which are particularly mentioned, and referred to, in the pleadings in this cause. And this deponent saith, he has been engaged as a civil engineer for upwards of thirty-nine years last past, and is well acquainted with, and has been extensively engaged in, the superintending and directing the construction and manufacture of machinery of various descriptions, and particularly steam-engines, and the various kinds of machinery for propelling vessels; and this deponent saith, that, after a very careful and minute examination of the paddle-wheel made by the said defendants, and described by the said model A, and also of the said specifications and drawings and model, claimed as the patent right of the said plaintiffs, and mentioned in the pleadings in this cause, this deponent saith, that, in the judgment, belief, and opinion of this deponent, the said paddle-wheel made by the said defendants as aforesaid, is not an infringement of, or colourable evasion, or colourable attempt to evade the patent of the said Elijah Galloway; and this deponent, further saith, that a paddle-wheel made as described and directed in and by the said specification and drawings, and agreeable to the patent of the said Elijah Galloway, under whom the said plaintiffs claim, would, in the opinion, judgment, and belief of this deponent be bad, defective, and unmechanical, and particularly as the shaft (which is, in all other wheels, the great support and stability of the wheel, and, for that reason, so constructed as to pass through the vessel's side, and through the wheel to the bearing placed on the outer framing of the paddle-box) of the said wheel claimed by the plaintiffs, is cut or separated into two parts close to the inside of the inner boss of the wheel, whereby the support and stability, which the shaft when entire is calculated for and intended to give to the wheel, are prevented or destroyed; and also, that only one boss and side of the said wheel are connected to the revolving part of the shaft, and whereby the whole strain and power of the engine are thrown on one side of the wheel, instead of being distributed equally to both sides of the wheel, as is the case when the shaft is entire; and also, that the hanging of the float-boards or paddles on one edge or end only, unnecessarily throws a great strain upon the spindles on which the float-boards or paddles turn, and more particularly upon the bent stems *f*, and the radial rods *g*, *h*, *i*, *j*, and *k*, and the disc A; and whereby the several parts last-mentioned are exposed to great and unnecessary wear and derangement; and also, that the position of crank B, and the bent stems *f*, cause the said stems and radial rods to assume the shape of a very obtuse angle at the time the float-board is vertical, and employed in exerting its greatest force and energy in or against the water, thereby causing great weakness and liability to accident; and in the opinion of deponent, a wheel so constructed, would be weak and dangerous, and unfit to be employed in propelling any steam-vessel; and this deponent saith, that he is unable, from the said specification and drawing of the said Elijah Galloway, to discover what is meant by "the required angle," as none is specifically named or pointed out, neither is there any description or definition of the necessary proportions or dimensions by which any angle can be produced, which, in the judgment and opinion of deponent, ought to have been done, to enable any mechanic to plan and set out the different parts of the wheel, in order to the making thereof. Saith, it has for several years been a subject of consideration with engineers, and others concerned in machinery for propelling vessels, to cause the float-boards of paddle-wheels to enter and leave the water edge-ways, as being a position supposed to be more advantageous, than the operation of the common and ordinary paddle-wheel, and which deponent believes to have been the object of the paddle-wheel in question, and claimed by the said plaintiffs, under the patent of the said Elijah Galloway, notwithstanding various patents and inventions for the same or similar purpose, had been previously obtained and published, as after mentioned. And this deponent saith, that in his judgment and belief, the principle of action in said wheel of the said plaintiffs, and by which the float-boards are made to enter and leave the water, is not new or original, and that the four parts claimed by the said Elijah Galloway, under the name of the radial rods, *g*, *h*, *i*, *j*, and *k*, the bent stems *f*, the disc A, and the crank, B, are not, nor are any or either of them new or original and on the contrary, the principle of action, as also the said four parts above mentioned, variously combined, have been used in many patents and inventions for paddle-wheels, previous to the date of the patent of the said Elijah Galloway, and particularly in the patent and specification of Robertson Buchannan, dated the 18th day of October, 1813, the patent of John Oldham, dated the 1st day of February,

1829, and the invention of Dr. Udney, as published by him in the *Mechanics' Magazine*, the 16th day of May, 1829; that is to say, in the said wheel of Robertson Buchannan are cranks, arms, or stems, connected to the ends of the float-boards, an excentric placed outside the wheel, against the side of the vessel; a collar or disc revolving on the excentric, and radial arms fixed to the collar by one end, and by the other end connected by moveable joints or pins, to the aforesaid cranks, arms, or stems. That in the wheel of the said John Oldham, are employed similar cranks, arms, or stems; an excentric outside the wheel, but moveable, and the same collar or disc, with fixed radial arms; and in Dr. Udney's invention there is employed the crank inside the wheel, the disc revolving on the crank, and the radial rods connected to the disc, by moveable joints or pins. Deponent saith, after a careful and minute examination of the wheel made by the said defendants, and applied to the said vessel, called the Levant, this deponent is certain, and convinced, that the said wheel of the defendants is not an infringement of the the said plaintiffs' patent, and that the said wheel so made by the said defendants, is much superior for strength, durability, and economy, to any wheel which has, or can be made, agreeable, or according to the said specification of Elijah Galloway, or any other wheel heretofore made, having similar action of the float-boards; deponent saith, that the form, construction, and arrangement of the wheels of the said plaintiffs and the defendants, are essentially different, although the principle of action whereby the float-boards are made to assume different positions during the revolution of the wheel is the same, or similar, in both, as also in the several other wheels before mentioned, yet the combination or arrangement of parts by which the said action is produced is very different in the two; saith, in the defendants' wheel, the shaft is continued through the vessel's side, and through the wheel to the bearing of the outer framing of the paddle-box, as in the common paddle-wheels, by which are produced and secured that strength and stability, so essential to the wheel, and, consequently, both sides take an equal share of the strain. Saith, the float-boards are balanced upon the spindles, which is an important advantage, and the strain thrown upon the radial rods and arms is inconsiderable, and takes place at the time when the rods and arms are in the most favourable position to receive or support the strain; in all which particulars, the defendants wheel is greatly superior to the wheel made according to, or described in, the said specification of Elijah Galloway's patent; and this deponent saith, that the employing the excentric, placed outside the wheel, and fixed to the vessel's side, with a collar revolving thereon, and connected by radial rods to arms or cranks fixed to one end of the float boards, is an arrangment by which the necessity of cutting the shaft in two is entirely avoided, and such arrangement is, therefore, far superior to the crank, and the other part of the combination adapted by Elijah Galloway, and as specified by him as aforesaid; and this deponent further saith, that by preserving the shaft entire, and fixing the excentric outside the wheel as aforesaid, the defendants have, in the judgment and opinion of this deponent, obtained a very great advantage and superiority over the wheel claimed by the plaintiffs; and this deponent verily believes, such arrangement was not used as a colourable evasion and infringement of the said Elijah Galloway's patent, as alleged by the plaintiffs. And this deponent saith, that the excentric collar, rods, and arms or cranks, used by the defendants, have all been heretofore employed, variously combined, in the same situation, and in the manufacture of paddle-wheels to produce the same or similar action by many other persons, before the date of Elijah Galloway's patent as aforesaid; and this deponent saith, that the use and employment by the defendants in their wheel of a separate arm and drag-link, to carry round the collar upon the excentric, is, in the judgment and opinion of deponent, of great utility and advantage, and by such arrangement the collar is made to move round with a more equal motion, and secure a greater degree of uniformity to the different float-boards, in the various positions which they assume; and in the judgment, opinion, and belief of deponent, the said arm and drag-link were and are not used by the defendants as a colourable evasion or infringement of the patent of the said Elijah Galloway, claimed by the plaintiffs. And this deponent further saith, that he has carefully examined the float-board of the defendants' paddle-wheel; and he has attended to and noticed the manner in which the arm is connected thereto at one end, and in the opinion and belief of deponent, the said mode or arrangement is by no means objectionable; that there is no twist or tendency to twist in the float-board, because the float-board being balanced on its spindle, it is not disposed to turn one way or the other.

Mr. Peter Barlow, F.R.S., and Mathematical Master in the Royal Academy, Woolwich, Saith, that, in his opinion, and according to the best of his judgment and belief, the paddle-wheel as manufactured by the defendants is not an infringement or an evasion and an attempt to evade the said patent of

Elijah Galloway; and, on the contrary, the said paddle-wheel made by the defendants, is, in the judgment and belief of deponent, far superior, in every respect, to that of the said Elijah Galloway; and this deponent saith, that, in his opinion and belief, the said paddle-wheel of the said Elijah Galloway, *as described in the specification* to his said patent, is weak and dangerous, and not fit to be used in propelling vessels,

Mr. J. Isaac Hawkins and *Mr. Bryan Donkin*, C. E., Say, that "they are decidedly of opinion that the wheel of the defendants is not an infringement" of the plaintiffs' patent—that the defendants' wheel is "much superior, for strength, durability, and economy, to any wheel made agreeably and according to the specification of E. Galloway"—that although "the principle of action, whereby the float-boards are made to assume different positions during the revolution of the wheel, is the same or similar in both (wheels), as also in the several older wheels before invented (Buchannan's, Oldham's, and Udny's), yet the combination or arrangement of parts by which the said action is produced is very different in the two"—that "by preserving the shaft entire, and fixing the eccentric outside the wheel, the defendants have, in the judgment of the deponents, obtained a very great advantage and superiority over the wheel claimed by the plaintiffs"—and that "the use and employment by the defendants in their wheel of a separate arm and drag-link to carry round the collar upon the eccentric" is also "a new and useful combination, by which the collar is made to move round with a more equal motion, and secure a greater degree of uniformity in the position of the float-boards."

Mr. Timothy Bramah and *Charles Collinge*, C.E., Say, also, that there is no infringement — that, "in their judgment, opinion, and belief, the construction, combination, and arrangement of the wheel made by the defendants, materially, essentially, and substantially differ from the construction, combination, and arrangement of the wheel" described in E. Galloway's specification.

Mr. John Hague, C. E., Saith, that he believes he fitted up and started the first steam-vessel on the river Thames—that he has made many paddle-wheels with vibrating float-boards, is well acquainted with the subject, and has had his attention particularly directed thereto—and that he considers the paddle-wheel of the defendants to be no infringement of the plaintiffs' patent, but, on the contrary, far superior to it in point of "strength, durability, and economy."

Mr. J. C. Robertson, Consulting Engineer, and Editor of the *Mechanics' Magazine*, bears testimony to the same effect as Mr. Hague.

Mr. John Barnes, C.E., Saith, that he has, for many years, been extensively engaged in the manufacture of steam-engines and machinery for propelling vessels; and this deponent, in the early part of the year one thousand eight hundred and twenty-*eight* was in France, superintending the fixing on board a vessel in the river Seine, a pair of steam-engines, manufactured by this deponent; and, on the sixteenth day of May, one thousand eight hundred and twenty-*eight*, this deponent having fixed the said engines, had a race on the said river Seine with a French steam-vessel called "La Seine," and which said vessel had then been recently fitted with and was working a pair of paddle-wheels made by Monsieur Cavé of Paris, and which said wheels had moveable float-boards, and so contrived as to enter and leave the water edge-ways, and nearly in a vertical position. Deponent saith, the said paddle-wheels were well known by the name of "Cavé's wheels;" deponent saith, that, for several years previous to the year one thousand eight hundred and twenty-*nine*, the manufacture of paddle-wheels with moveable float-boards, and so constructed as to cause the said float-boards to enter and leave the water edge-ways, were well known, and, as deponent verily believes, to most, if not all, practical engineers, and persons concerned in the manufacture of machines for propelling vessels; and that the use and application of radial rods, bent stems, or cranks, a disc, an excentric, and collar, were well known and understood; and that their use and application for such purpose was not, in the year one thousand eight hundred and twenty-*nine*, and had not, for many years previous, been a novelty. Deponent saith, in his opinion, judgment, and belief, the wheel made by said defendants is not an infringement, or a colourable evasion, nor does there appear to deponent any attempt to evade the patent and wheel of the said Elijah Galloway; and, on the contrary, this deponent considers and verily believes the said wheel of the defendants an arrangement very different and far superior to that of the said Elijah Galloway. Saith, he is of opinion, that the said wheel of the said Elijah Galloway, agreeably to his specification, is not only unmechanical, and very badly constructed, but, in the judgment and belief of deponent, would be weak and dangerous, and unfit to be employed in propelling steam-vessels.

Mr. Edward Slaughter, C.E., Saith, that he has been several times in Paris, and other parts of France, and his attention has been particularly drawn and directed to the manu-

facture of steam-engines and machinery for propelling vessels, and this deponent has been permitted to inspect the manufactory of Monsieur Cavé at Paris.

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Saith further, that the French packet called "The Courier," running from Calais to Dover, is fitted with a pair of the said wheels, and has been running from Calais to Dover and back with the said wheels from the month of October 1830 until the present time.

Mr. H. G. Williams, Working Engineer, Saith, that he was, for several years, and particularly from the year 1826 to the year 1828, employed as a working engineer in France, and in steam-boats running on the river Seine. Deponent saith, that he is well acquainted with the paddle-wheel which was and is called and known as "Cavé's wheel." Deponent saith, that, in the latter part of 1828, he was employed at Rouen in fixing a pair of engines in a steam-packet belonging to the French Government, and this deponent saith, that, during the time he was so employed as aforesaid, a pair of wheels similar to Mr. Cavé's were fixed to a vessel then running from Rouen to Havre. Deponent saith, that he had frequent opportunities of examining, and did examine, the said wheels; and, at the same time, many other English mechanics and engineers, and, according to deponent's recollection and belief, at least twenty in number were at the same time residing at Rouen aforesaid, many of whom were employed in fitting up the said last-mentioned, and one other steam-packet on the said Seine, and that English workmen and mechanics were in the habit of working there, and the said wheels and the principles on which they worked were well known.

The Earl of Dundonald, Saith, that for many years past he has directed his attention to mechanical subjects, and particularly to the improvement of steam-engines and machinery for propelling vessels, and this deponent has taken out many patents connected with those subjects. And deponent saith, that many years ago he became and was well acquainted with the principle on which the float-boards of paddle-wheels by the use and application of radial rods, arms, or stems with cranks, and other mechanical contrivances, were made to vibrate on their axis, and made to enter and leave the water edge-ways, and that in or about the year 1822, a steam-vessel called the Rising Star was fitted out by deponent's orders under the direction of the Honourable William Erskine Cochrane, and had a paddle-wheel upon the said principle. And this deponent says, that in such wheel the float-boards vibrated upon an axis by means of arms or cranks placed on one end of the said float-boards, and that there were in the said wheel connecting rods or rods attached by one end to the aforesaid arms or cranks, and by the other to a collar or band, which revolved round fixed rollers (which were bolted to the paddle-box, and through which the main shaft or axle of the engine passed). And deponent says, the said vessel was sent to this deponent, then in South America, and the said vessel worked with the said paddle-wheel at Valparaiso, and the said principle and means by which the float-boards were made to vibrate as aforesaid proved efficient. And this deponent says, he has examined an office copy of the specification and the drawing of the paddle-wheels of Elijah Galloway, and this deponent is well acquainted with its mechanical combinations and mode of action. And this deponent says, he is also well acquainted with the paddle-wheels manufactured by the defendants, as fixed by them to the Levant steam-boat, this deponent having seen and examined the same when so fixed to the said vessel. And this deponent says, that in his opinion, judgment, and belief, the combination and arrangement of the said paddle-wheel, so made by the said defendants as aforesaid, is not an infringement or colourable attempt to evade the patent of the said Elijah Galloway; and, on the contrary, this deponent verily believes, the combination of the several parts, and the arrangement of the said wheel of the defendants, are essentially and substantially different, and were well known and in use previous to the existence of the patent of the said Elijah Galloway.

The Hon. William Erskine Cochrane confirms the statements in the affidavit of his brother, the Earl of Dundonald, with respect to the manner in which the Rising Star was fitted out.

King Williams, Engineer, Saith, that in or about the month of January, 1829, he made a model (now produced) of a new paddle-wheel of his invention, which "was exhibited to mechanics, and various other persons in this country, between the month of April, 1829, and the 2d of July, 1829" (the date of E. Galloway's patent*).

Mr. Alexander Gordon, C. E., Saith, that he knows Elijah Galloway, the person mentioned as the patentee in the pleadings of this cause; and the said Elijah Galloway, on or about the twenty-third day of June last, informed this deponent, and which information this deponent verily believes to be true,

* A description of this wheel, illustrated by engravings, was published in the Phil. Mag. for February, 1830. It is identical with E. Galloway's wheel, at first constructed.

that he was aware, and knows, that a paddle-wheel precisely similar to the one claimed by him, and for which the said patent was obtained, had been in use four years previously to his said patent; and, also, that one King Williams, a working mechanic, had made a model of a paddle-wheel of the same description, and exhibited the same before the said patent was sealed.

Benjamin Chapman, Working Engineer, Saith, that he was brought up to the business, and worked for Mr. Curtis, an engineer of Bermondsey, for twelve months, and until, and in the month of May, one thousand eight hundred and twenty-*nine*. Saith, that, during the time he was at work for the said Mr. Curtis, as aforesaid, two pair of paddle-wheels were made, and in the manufacture of which deponent assisted, and the same were made with moveable float-boards; and the said two pair of wheels were made *openly* in the workshop of the said Mr. Curtis, and, as deponent understood and believes, were made for sale.

* * * * * *

Saith, he understood and believes the said two pair of paddle-wheels were so made for the plaintiff, William Morgan; and this deponent verily believes the model now shown to this deponent at the time of making this affidavit, and marked with the letter B, is a correct representation of the said wheels;* and deponent saith, that one Elijah Galloway was constantly with the said William Morgan, and assisted in and superintended the making of the said wheels; and deponent understood that the said Elijah Galloway claimed to have invented the combination or arrangement of the said wheels. Deponent saith, he recollects having seen a model precisely similar to the said wheels so made, at the manufactory of the said Mr. Curtis as aforesaid, and which said model was made by one King Williams, a working engineer; and that the said last-mentioned model was publicly exhibited and seen by many persons in the early part of the year one thousand eight hundred and twenty-*nine*, and during the time deponent was at work for the said Mr. Curtis as aforesaid.

Joseph Tunnicliffe and *John Nugent*, Working Engineers, Say, that they have been brought up as working engineers, and in the beginning of the year one thousand eight hundred and thirty, these deponents were employed by the plaintiff, William Morgan, as engineers, and well recollect a pair of paddle-wheels, which were represented to be upon the plan of the patent of Elijah Galloway, and mentioned in the pleadings of this cause, being fixed to his Majesty's vessel the Confiance; and which said last-mentioned wheels, deponents understood and believe, were the second pair of wheels fixed to the said vessel by the said William Morgan. Deponents say, that about three months after the said second pair of wheels were so fixed, they were taken out of the said vessel for repair, as they had given way and failed, and in particular the bent stems, and the spindles on which the paddles turn, were nearly all broken or twisted out of shape, so as to be rendered useless for the purpose required; and they were afterwards, as deponents understood and believe, sold for old iron. And deponents say, they believe that the said second pair of paddle-wheels were considered, from their construction, to be weak and unfit for use without additional strength and arrangement. Deponents further say, they were also employed as working engineers to assist in fitting up a third pair of wheels, which were made by the said William Morgan for the said vessel, called the Confiance; and in the last-mentioned wheels several alterations and additions were made in consequence of the weakness and inutility of those made according to the said specification, and particularly in the form of the bent stem, and also by the introduction of certain diagonal as well as cross stays or braces, which were not used or applied in the former wheels made and fitted to the vessel as aforesaid; and for this purpose the said vessel was detained a considerable time, and, according to the best of deponent's recollection and belief, for a period of three months. Deponents say, that about twelve months after the said third pair of wheels had been fixed to the said vessel, the Confiance, as aforesaid, they were so worn and deranged as to require very extensive repair; and for that purpose the said vessel was necessarily detained several weeks; and at the end of about eighteen months the said wheels were in such a bad state as again to require very extensive repair, and the said vessel was detained for that purpose for about three months. And deponents say, that in order to complete the last-mentioned repair, the wheels were nearly taken to pieces, as all or the greater part of the working or wearing parts were worn out. Deponents further say, they were also employed by the said plaintiff, William Morgan, and assisted in making a pair of paddle-wheels for his Majesty's vessel the Flamer, which was fitted out at Woolwich in or about the month of November, one thousand eight hundred and thirty-one; and the said last-mentioned wheels were made similar to the third pair of wheels made for the Confiance, with the additions and alterations as aforesaid, and which varied very much from those originally made under the said

* The model here referred to is one of a wheel constructed according to E. Galloway's specification.

patent and specification of the said Elijah Galloway, and particularly in the form of the bent stem, the alteration in hanging the float-boards, and the introduction of diagonal and cross stays or braces.

Mr. C. W. R. Rickard, Saith, that in the early part of the year one thousand eight hundred and twenty-eight, he was working for Mr. Brown, the engineer, and inventor of the gas-vacuum engine, at his manufactory at Chelsea; and that in the summer of that year he was employed by Mr. Brown to make the model of a paddle-wheel with vibrating paddles or float-boards, the action of which was produced by means of a disc or collar revolving upon a crank, with rods connected to the arms or stems of the paddles; and that the crank aforesaid was affixed to or attached to the shaft which passed through the wheel, and was so contrived that the crank could be made to turn round and assume any position, so that the float-boards could be made to enter and leave the water in the manner and position well known to engineers, and generally the most desirable for assisting in propelling the vessel. And deponent says, that the said model was completed by him openly in the shop among numbers of workmen; and that it was afterwards publicly shown and exhibited to many persons, gentlemen, and others, who visited the factory of the said Mr. Brown.

Additional Affidavits in support of the Injunction.

The plaintiffs, in reply to the case of the defendants, produced the following additional affidavits:—

Mr. William Morgan Saith, that the hanging of the float-boards below the centres on which the bent stems vibrate, does not form any part of the patented combination of implements or parts to produce the angle which may be required; and that he has, ever since the end of 1832, hung his float-boards, so that the strain should be divided and more equally applied. And this deponent further saith, that such improvement in the hanging of the float-boards, and also other improvements in the forms and proportions of some parts of the paddle-wheels, have been introduced gradually from time to time, when and as their expediency occurred to this deponent, since the date of the said specification. And this deponent further saith, that, the mode of giving the required angle to the float-boards or paddles is preserved in the said paddle-wheels, as now constructed by this deponent. And this deponent further saith, he denies that there is any obscurity in the expression "the required angle," used in the said specification; or that any definite angle at which the float-boards should enter and leave the water could with propriety have been, or could now be specified; for it is clear to those who are really conversant with the subject, that no one particular angle can be determined or given as expedient in all cases, because no one angle can be alike applicable to the varying and variable circumstances to which different ships or vessels, and at times the same ships or vessels, must be subjected; and no rule could have been, or could now be laid down, by which such changing circumstances could be foreseen and provided. And this deponent further saith, that he hath read an office copy of an affidavit of Joseph Tunnicliffe and John Nugent, sworn and filed in this cause on the twenty-ninth day of June last, and that he denies that the set of paddle-wheels in the said affidavit, called the second set, was constructed in accordance with the said specification; and, on the contrary, this deponent saith, they were made with some deviations therefrom, and that such deviations proved to be injudicious, rendering the said paddle-wheels weak, and the same, in consequence, became useless. And this deponent further saith, that the said second set of paddle-wheels was replaced by the set of paddle-wheels in the said affidavit of the said Joseph Tunnicliffe and John Nugent, called the third set; and that the said third set of paddle-wheels was made according to the said specification, with additional bearings for the float-boards, and diagonal trussings to the frames; and that the said additional bearings and diagonal trussings were found to be necessary, on account of the unusual breadth of the paddle-wheels, occasioned by their having been ordered to fit into the paddle-boxes constructed for the old common paddle-wheels of the vessel, called the Confiance; and this deponent further says, that the said third set of paddle-wheels was fitted to the said vessel, Confiance, in August 1830; and that, according to the best of this deponent's recollection and belief, no repairs were done to the same by this deponent, or by his order, or under his direction, or by any other person on his account, till June 1832, except that the two outer brasses of the said paddle-wheels being of bad metal, cracked, and this deponent at his own charge replaced them.

* * * * * *

And this deponent further saith, that the paddle-wheels fitted by this deponent to his Majesty's vessel the Flamer, in the said affidavit of the said Joseph Tunnicliffe and John Nugent mentioned, were made in accordance with the said specification, and that the alterations in the said affidavit mentioned were some of the improvements hereinbefore referred to and explained, but they were in no respect a deviation from the

combination of implements or parts described and claimed in the said specification, as the mode of giving the required angle to the float-boards or paddles.

* * * * * *

And this deponent further saith, that, late in the month of November 1829, King Williams called at this deponent's former factory in Holland-street, and produced to this deponent a model of paddle-wheels, and pretended that he had invented such wheels, and he offered to this deponent to suppress the alleged fact of his having invented the said wheels, if this deponent would give him a job and buy his model; and this deponent further saith, that he immediately discovered that the said model was an exact representation of the paddle-wheels constructed by the said Elijah Galloway, according to the description in the said specification, at Mr. Curtis's factory, and, upon closely questioning the said King Williams as to the nature and properties of the said paddle-wheels, the said King Williams showed that he was ignorant thereof, and then he contradicted his former assertion, and said the fact was, that the invention was communicated to him by a gentleman on the Rhine; and that, thereupon, this deponent produced to the said King Williams the original drawing from which the said paddle-wheels had been constructed at Mr. Curtis's factory, and in the presence of the said King Williams, this deponent measured the various parts of the said drawing and of the said King Williams's model, and showed him that the dimensions were, as in fact they were, precisely the same, and upon the same scale. And this deponent further saith, that he then sent in for some of his workmen, and in their presence declined employing the said King Williams, or purchasing his said model; but this deponent first asked them if they had ever seen any thing like that model, and they all immediately replied, that it was a model of the small set of paddle-wheels made at Mr. Curtis's; and this deponent further saith, that the said Elijah Galloway came in at that moment, and thereupon this deponent left the said King Williams and Elijah Galloway, and some of the workmen together, and on this deponent's return to the said factory, he was informed of the admission which the said King Williams had made, of his having constructed the said model from information obtained by him in Mr. Curtis's factory.

Mr. Robert Jefferys, Working Engineer, Saith, that, early in the spring of 1829, Mr. E. Galloway showed him "a sketch or drawing of paddle-wheels, which he told deponent he had invented, and in which there was the same or a similar combination of instruments to give the required angle to the paddle-floats in entering and leaving the water," as that which was subsequently patented by him, and described in his specification. Saith, that he superintended the construction of the first two pairs of wheels constructed on this principle at Mr. Curtis's factory; and that after the different parts of the said paddle-wheels had been constructed, and were in the progress of being connected together, admittance to the said factory was not allowed to strangers; but that at that period this deponent saw King Williams in the said factory, where the said paddle-wheels were, during the dinner hour; and that the said King Williams saw the smaller set of paddle-wheels, which had four float-boards; and that this deponent complained of the said King Williams having been admitted there, and that this deponent never saw him there again.

* * * * * *

And this deponent further saith, that towards the latter end of 1829, and, as he best recollects and believes, in the month of November, he saw at the factory of the plaintiff, William Morgan, in Holland-street, a model, brought there by King Williams, and which the said King Williams then declared he had made, of a paddle-wheel; and that the said model was the model of a paddle-wheel with four float-boards or paddles, and was exactly similar to the said smaller set of paddle-wheels constructed at Mr. Curtis's, and seen by King Williams.

Samuel Lane, Smith, Saith, that he assisted in forging various parts of the wheels made at Curtis's factory, and "gave privately to King Williams information and sketches to enable him to prepare, and by means of which he prepared," the model which he afterwards exhibited to Mr. Morgan, with the exception of the crank, which was forged for Williams by this deponent himself.

Benjamin Chapman, Working Engineer, and *William Phillips*, Smith, Say, that they worked at Curtis's factory at the time the wheels were made there; and heard King Williams make the confession mentioned in Mr. Morgan's (2d) affidavit. And Chapman saith further, that he made an affidavit of the fact before Sir Peter Laurie, Alderman, on the 23d of January, 1830.

Benjamin Holland, Working Engineer, Saith, that King Williams repeatedly confessed to him that his model was a copy of Mr. Galloway's wheel.

Lieutenant William Henry Symons, Saith, that for upwards of five years and a half, and up to the month of April, 1834, he had the command of H. M.'s steam-vessel the Meteor, which was fitted with common paddle-wheels, and was employed during such the period of his command thereof, on general service in the Channel, and in the conveyance of the mails to the Mediterranean, and to Lis-

tion, and also in general service in the Mediterranean station; and this deponent further saith, that in May, 1834, he was appointed to the temporary command of H. M.'s steam-vessel the Spitfire, which was fitted by the plaintiff, William Morgan, with his patented wheels, known better under the appellation of Morgan's wheels, under the inspection of this deponent, and was navigated with the said wheels during the whole period of this deponent's command thereof, which continued till the expiration of the voyage hereinafter mentioned. And this deponent further saith, that the said vessel, the Spitfire, whilst under his command, proceeded from Falmouth in the month of August, 1834, on a voyage to Corfu, and returned to Falmouth in September following, and that the said paddle-wheels during the whole of the said voyage were in perfect order, and fully performed their duty; that no repairs or refitting of any kind were or was done or required to the said paddle-wheels, and that at the conclusion of the said voyage, they were in all respects in as good a state and condition as the same were in at the commencement; that, whilst on all occasions during a voyage of the same description, in the Meteor, propelled by the common paddle-wheels, he was obliged to lay the vessel to, at least every two days, to screw up the bolts of the paddles, and generally with a loss of two or three bolts and nuts, and a detention, upon an average, of about one hour on every such occasion, and on her arrival at the ports of Gibraltar, Malta, and Corfu, from Plymouth to Corfu, the engineers were obliged to be employed at each of the said ports at least four hours in overhauling the wheels, and repairing them fit for the return voyage; and this deponent further saith, that during his command of the two vessels, the Meteor and Spitfire respectively, he paid particular attention to the working of the wheels used in the same respectively, and that he took especial notice of their performance in propelling the said vessels, and that the result of his observation was, and such now remains this deponent's opinion, that the greatest benefit had been conferred on steam-navigation by the invention and application of Morgan's paddle-wheels; that such paddle-wheels, as compared with the common wheels, make a difference of from one to two miles an hour going head to wind and against a rough and heavy sea, in particular; and also that the trembling of the vessel, which, when propelled by the common wheels, is very considerable, and is injurious to the machinery and vessel itself, as well as disagreeable to all persons on board, is scarcely perceptible when the vessel is propelled with Morgan's wheels. And this deponent further saith, that in the said voyage of the Spitfire, both out and home, she conveyed numerous passengers, and that many of the said passengers during the said voyage, expressed their admiration of the said paddle-wheels; and this deponent further saith, that from his observation of the performance of the said Morgan's wheels, during the voyage of the Spitfire, and especially in her passage through the Bay of Biscay, he is well satisfied of their great superiority over the common wheels, and he would have no hesitation in sailing in a vessel fitted with the said wheels in the roughest seas, and during the most tempestuous weather.

Mr. Joseph Clement and *Mr. George Cottam*, Engineers, Say, that, to the best of their knowledge and belief, the plaintiffs' paddle-wheel was entirely *new* at the time of the patent for it being sealed—that they consider the defendants' wheel to be "only a colourable expedient to evade the said patent," the "same character of combination" being recognisable in both—that neither in the wheel of Robertson Buchannan, nor in that of Mr. Oldham, nor in that of Dr. Uduy, is there "the mode of actuating the float-boards" described in the specification of E. Galloway—that "in the wheel of Robertson Buchannan the float-boards are not affixed to bent stems, as is the case in E. Galloway's invention, but the float-boards are affixed to moveable spindles, each of which spindles has a crank attached to its inner end, and the cranks are by a series of radial arms all of them fixed, or, as Robertson Buchannan's said specification describes it, a connecting-ring, acted on in such manner that their nave or boss, moving on an eccentric, causes all the float-boards to be at all times parallel to each other, and, consequently, renders the paddle-wheel a most inefficient one—that a paddle-wheel constructed according to the said Robertson Buchannan's said specification, would, as a means of propelling vessels, be very inferior to the common wheel with the ordinary radial floats—that by the mode of operating on the float-boards described in the specification of E. Galloway's invention, no two float-boards can be parallel to each other, but all the float-boards are caused to enter and leave the water in the direction best calculated to giving full effect to the power employed—that in the said invention of Oldham, the float-boards are affixed to the spindles, and not, as is the case with the plaintiffs' float-boards, to bent stems; that the spindles are actuated by means precisely similar to those employed in the wheel of Robertson Buchannan, but with the addition, that not only the eccentric wheel, but also the eccentric axis itself in Oldham's wheel is made to revolve, and the same respectively are so made to revolve by means of cog-wheels—that it does not appear from the

letter-press or engravings of Dr. Udny's invention, nor could it upon a proper and careful examination thereof be inferred from them, or either of them, that in the invention of Dr. Udny, there are rods connected to a disc or collar, by moveable pins or joints, as stated in the affidavits of William Brunton, John Isaac Hawkins, Bryan Donkin, and John Donkin; and that, on the contrary, there is no mention or notice in the said letter-press or engravings of any such moveable joints or pins, but the reverse is clearly shown by the engravings, where the rods which were intended to move the float-boards, appear to be solid with the collar; and also by some of the expressions used in the letter-press—and that the said plan or system of Dr. Udny is, in their opinion and judgment, absolutely unavailing and useless.

Mr. M. J. Brunel and *Mr. Carpmael*, testify to the same effect, and in the same terms, as Messrs. Clement and Cottam respecting the wheels of Buchannan, Oldham, and Udny.

Commander *John Allen*, of H.M.'s steam-vessel Firebrand, Commander *Thomas Allen*, of H.M.'s steam-vessel Lightning, and *Robert Rastrick*, Chief Engineer of the Lightning, make oath as follows:—Commander *John Allen* saith, that he commanded the Lightning for several years, and up to the month of April, 1834; and that until the month of August, 1833, she was propelled by common paddle-wheels, but in that month she was fitted, under this deponent's inspection, with Morgan's wheels, and continued to be propelled by them so long as this deponent remained in the command of her—that in April, 1834, he was appointed to the command of the Firebrand, and has continued in the command thereof from that time to the present, and that during the whole of that period the last-mentioned vessel has been propelled by Morgan's wheels.—Commander *Thomas Allen* saith, that for several years he was the commander of H.M.'s steam-vessel Comet, which was fitted with common wheels, and that in April, 1834, he was appointed to succeed Commander John Allen in the command of the Lightning, and he has continued in the command thereof from that time to the present;—and *Robert Rastrick* saith, that for the last eight years and upwards, this deponent hath been, and still is the chief engineer of the Lightning; and Commander *John Allen* further saith, that having been requested by the plaintiff, William Morgan, to report to him this deponent's opinion respecting the performance of the said patented wheels, fitted to the said vessel Lightning, this deponent, on the 11th of January, 1834, wrote, and sent to the said plaintiff, William Morgan a letter, in the words following:—

"In compliance with the request in your letter of the 20th of November last, I forward you a statement of the performances of your patent paddle-wheels, as substituted for the common paddle-wheels, per Admiralty order, to his H. M.'s steam-vessel Lightning, under my command, with my opinion partially thereon. It will occur to you, that your wheels were fitted to this vessel in August last, since which time she has been frequently and variously employed upon his Majesty's service, in the English Channel, between Milford, Plymouth, the River Thames, on the Coast of France, &c. &c.; and latterly, with his Majesty's mails from England to Corunna, Oporto, Lisbon, and back; on which services we have frequently met with hard gales and tempestuous weather, in all which cases we have clearly ascertained, that since the application of your wheels to this vessel her speed is very materially increased, and particularly so with adverse winds, and in a head sea; which are very material points in their favour, and which, in my opinion, gives to them a very decided advantage over the common paddle-wheel as hitherto in use in this vessel, together with having nearly done away with the vibration or tremulous motion, as before so much felt. With regard to their durability or lasting qualities, I can only say, that after being in use from the before-mentioned period to the present time, they now appear to be in as perfect a state as when first fitted. Under the aforegoing considerations, I can have no hesitation in recommending your patent paddle-wheels as a great improvement in steam navigation, particularly so in sea-going vessels." —Commander *John Allen* further saith, that the experience which he has since had in the Lightning and Firebrand, of the said patented wheels fitted to both the same vessels, has confirmed the opinion so expressed in the said letter, and that he considers these wheels very superior in all respects to the common paddle-wheels, or any other wheels he ever saw.—Commander *Thomas Allen* and *Robert Rastrick* say, that they entirely concur in the opinion expressed in Commander John Allen's letter—that during the period of Commander Thos. Allen's command of the Lightning, she has been almost continually on service, engaged in voyages to and from Sweden, Hamburgh, and the coast of Holland, and in the Irish Channel and elsewhere; and in the course of such voyages and service, has frequently been exposed to tempestuous weather—that in particular when on her passage from Stockholm, in October last, the Lightning was in successive heavy gales, and was exposed for five days to a heavy gale in the North Sea, occasionally lying to; and that she was lying to in the same gale in which the General

Steam Navigation Company's steam-packet, the Superb, fitted with common paddle-wheels, foundered in the North Sea—that notwithstanding the extreme severity of the weather, and the violence of the waves to which the wheels had been thus exposed, not only whilst they were in motion, but also whilst the vessel was lying to, the wheels did not sustain the slightest injury or strain; and that during all the severe weather, as well as at all other times during the voyages of the Lightning, whilst the wheels were in motion, they were found to be fully effective, and in their performance very far superior to what, under the same circumstances, would have been the operation of common wheels, or any other wheels which these deponents are acquinted with.—And Commander *John Allen*, Commander *Thomas Allen*, and *Robert Rastrick*, further say, that from the experience which they have severally had, they are respectively so well satisfied of the effectiveness of Morgan's wheels, and their superiority over all other kinds of wheels, during the worst of weather, that they would without hesitation, and without any apprehension of the wheels giving way, go over the world in vessels fitted with Morgan's wheels.—*Robert Rastrick* further saith, that since Morgan's wheels were fitted to the Lightning, although she has occasionally encountered the worst of weather, and been in constant employ, he has never found it necessary to do any repairs whatever to the said wheels—that there has never been even a key or screw loose therein—that the wheels are now in a perfectly sound and effective state, and that the only perceptible deterioration is, that the bearings of the spindles are somewhat reduced, which this deponent, from his observation, believes to have been from corrosion, but not so as to affect the stability and due action of the wheels—that whilst the Lightning was propelled with common wheels, he has found that in what is called a following sea, he was obliged to stand with the regulator of the throttle-valve in his hand ready to shut off the steam, in order to save the engines from injury, and perhaps from fracture; but that since the vessel has been propelled by Morgan's wheels, he has been under no such necessity, having been relieved therefrom by the equable action of the wheels.—Commander *Thomas Allen* and *Robert Rastrick* further say, that from the experience which they have respectively had of Morgan's patented wheels, they are convinced that the fact of the shaft not passing through the wheel is in no way injurious.

Colonel *George Whitmore*, of the Royal Engineers, Saith, that in the month of August, 1834, he embarked on board the Spitfire, then commanded by Lieutenant Symons, and proceeded in her from Falmouth to Corfu; and in November following, returned to England in the same vessel, then commanded by Lieutenant Kennedy—that the said vessel was during the said voyage out and home propelled by Morgan's patent wheels—that the said voyage from Falmouth to Corfu was performed in something less than thirteen days' steaming, to the best of this deponent's recollection—that he observed the absence from the vessel of that tremulous motion so general in vessels propelled by steam, and also the very dry state of the decks of the vessel; both which circumstances this deponent attributed and still believes were owing to the highly ingenious mechanism of the paddle-wheels—and that on the voyage home the vessel experienced for several days a severe gale, attended by a head-sea, and carried away her mainmast; but that the paddle-wheels under the said circumstances, as well as on all other occasions during the said voyage out and home, were perfectly effective in operation.

William Wheldon, Working Engineer, and *Benjamin George Chapman* (a previous witness), confirm that part of Mr. Morgan's (2d) affidavit which goes to contradict the statement made by Tunnicliffe and Nugent respecting the alterations and repairs required in the case of the Confiance.

Mr. E. Galloway Saith, that what Mr. Alexander Gordon "has stated and sworn in his affidavit is false in every particular;" and that so far from having made the admissions ascribed to him by Mr. Gordon, "he declared to the said Alexander Gordon, which declaration was and is true, that he knew of no fact which would injure the validity of the said patent." Confirms further, in all respects, Mr. Morgan's statement with respect to King Williams.

Additional Affidavit for Dissolving the Injunction.

To counteract those parts of the affidavits produced in reply by the plaintiffs which relate to the repairs required in the case of the Confiance, the following additional affidavit was lodged for the defendants:—

Mr. Samuel Seaward (one of the defendants) Saith, that, after much trouble, he has obtained the following "correct account of money charged and paid the plaintiffs by Government on account of the Confiance:"—

	£.
1831. The costs of the wheels, with shafts, &c., for a pair of engines	1,984
Up to the month of July, in the year following, the repairs of these wheels amounted to............	400
Carried forward	2,384

Brought forward	2,334
And to October of the same year, 1832, for duplicate articles supplied	196
And to May, 1834, repairs	105
And to June, 1834, the repairs and removal of the wheels	1,256
	£3,891

[In the preceding abstract of the evidence several affidavits on both sides have been omitted which relate to mere matters of form required to be authenticated, or to points of conduct which have no bearing on the substantial question at issue.]

The case made out by these affidavits was argued at great length, and with a degree of ability to which the Court did afterwards no more than justice, by Mr. Knight, Mr. Jacob, and Mr. Richards, for the plaintiffs; and by the Solicitor-General (Sir R. M. Rolfe), Mr. David Pollock, and Mr. Thomas Parker, for the defendants. The Vice-Chancellor signified early on the third day that he had made up his mind to dissolve the Injunction, on the condition of the defendants keeping an account; but the Counsel for the plaintiffs declined accepting judgment on these terms, and occupied the remainder of the hearing in a gallant but unavailing effort to obtain better terms for their clients.

The Judgment.

(From the Short-hand Writer's Notes.)

The Vice-Chancellor.—This case has been argued with great ingenuity and ability, and, from the beginning to the end, setting aside what I may call the mere offsets of the case,—observations on conduct, and other things which do not, at present, appear to me to be material for consideration,—the whole thing at last has been reduced to this simple question, namely, whether the introduction of the eccentric motion, for the purpose of regulating the paddles, is produced by the same combination of machinery in the defendant's engine as in the plaintiffs' engine? Now, it does appear to me, upon reading the specification, that the patentee meant to rest his right of protection under the patent, on his having discovered a mode of producing a certain motion, by the combination of certain *instruments* therein specified; and that was the notion that struck me before I read the affidavit of Mr. Jeffrey; aud when I read that affidavit of Mr. Jeffrey, which was made on the part of the plaintiff, I could not help being struck with the circumstance, that he has, three times, used the language, which, from the beginning to the end, appeared to me to be suitable to describe exactly the nature of the plaintiffs' invention, namely, that it consists of a combination of certain specified *instruments* to produce the particular effect desired. The patentee confines himself, in his specification, to 4 pieces of machinery; namely, the rods, the bent stems, the disc, and the crank. He might, perhaps, if he had been asked the question at the time when he was drawing his specification, "Do you mean, sir, to confine the motion of the disc to the motion of a disc upon a crank, or might not that motion be produced by any other suitable means?"—why, with the knowledge of machinery he has, he might have answered, "I don't mean to confine myself to a crank, but it may be produced by any other similar means;" which, by the way, would have been only observing the same laxity of expression which he has employed in speaking of the straps and the screws; or he might have said, "this motion may be produced, either by the disc revolving by means of a crank, or by means of an eccentric, and what is called a collar." But, since he has not done so, and has thought proper to specify four instruments only which are to produce the combination for which he has taken out his patent, it does appear to me that he cannot go beyond them. The question reduces itself to this—whether the defendants' eccentric with a collar is the same thing in substance as the crank? Now, it is plain, that in the plaintiffs', the crank in the model which I have before me, is what may be called a double crank; because there is a crank from each portion of that thing which must be called the axis. The effect of this double crank is to weaken the axis; I take this to be the infallible consequence. Now, in the defendant's wheel, the axis is preserved entirely unbroken and unencumbered; you have no crank, that is nothing which projects from the

axle of the main wheel; and this does appear to me to be a most important the axle itself turning in the centre of the eccentric, and then the collar variation. You have, in effect, it is true, revolving upon the eccentric. But there is this most important thing gained—these things, I should rather say—*first*, the unbroken strength of the axle for the main wheel; and *secondly*, the avoidance of that perpetual vibration upon the outer part, and every part of the frame work, which supports the wheels; you transfer the vibrating, and what I would call the destroying power, from this portion of the machinery, which by the reason of its being the weakest, is least able to support it, to that place where the vibration can produce no ill effect; because, if it affects any thing, it affects the side of the vessel, which is made suitably strong for the purpose. And though I am willing to admit that the mere lateral action, the unilateral action of the bent stems, by means of the eccentric, and the collar upon the paddles, may tend, in some measure, to distress the paddles, and to distort them, yet you must set one evil against another, and it will be a question for a jury to consider, whether, on the whole, there is an improvement or not. I cannot but myself feel inclined to the impression, that the alteration which has been made by the defendants is *not* a mere *colourable* attempt to evade the plaintiffs' patent, but one which, *primâ facie*, may be considered an improvement; and an improvement not by means of the combination of the *instruments* which the plaintiff has combined together in his specification, but by introducing into the combination of some things not intended or dreamed of in the specification of the plaintiffs. I think, therefore, that this is as proper a case to be sent to be tried, both upon the question of fact of colourable evasion, and upon the question of law that may arise on the patent, as any question that was ever sent for the consideration of that which the law of the land has established as the proper tribunal for determining such questions.

Well, then, the next question that arises, is a question peculiarly confined to the consideration of this Court, namely, what is intermediately to be done? Now, it is possible, that the jury may find that this is no infringement; and, if that be the case, and I continue the injunction, where is the justice that can make a compensation to the defendants? There is no power by which this Court ever makes a plaintiff give the defendant damages by reason of having continued the injunction longer than it ought to have been. So, that, in that way of putting the case—in that view the defendants will have suffered a wrong, and the plaintiffs have gained an advantage to which they have no right. But take it the other way, that the jury find that it is an infraction, what is the damage the plaintiffs are likely to suffer? Why, that their engines might be sold by the defendants, and a profit made; but the Court of Chancery has a jurisdiction over a wrong-doer when he stands in the shape of a defendant; and, I apprehend, that with respect to that which is really the main thing, namely, the completion of the present contract, and the entering into similar contracts, there is complete security that full justice will be done to the plaintiffs in the event of the jury finding for them, by taking an account, which, it appears to me, will be an extremely simple account to take, and one which there is no reason to suppose can be evaded. The sale of a vessel must be a matter of some notoriety; it cannot be transacted like a secret sale in a corner, of some small article with an unknown purchaser; the thing itself has notoriety attached to it, and that notoriety, it appears to me, will secure to the plaintiffs what they may be justly entitled to. On the whole, therefore, it does appear to me, that the proper order to be made will be this:—that the plaintiffs shall forthwith bring such action as they may be advised.

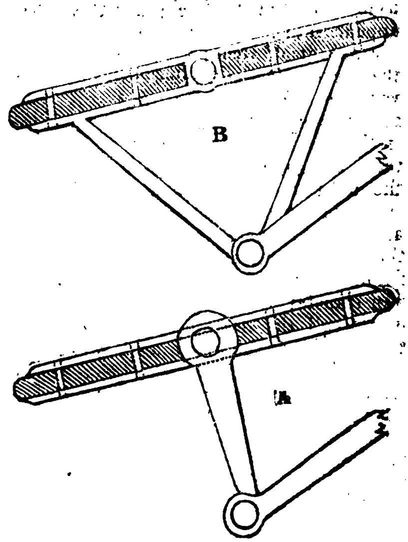
Mr. Knight.—Or either of them.

The Vice-Chancellor.—Yes, the plaintiffs, or either of them.

The Solicitor-General.—We will be bound to make no objection as to that.

The Vice-Chancellor.—Let the plaintiffs, or either of them, be at liberty to bring such action as he or they may be advised forthwith, and let the injunction be dissolved, the defendants undertaking to submit to such order as the

Court may make respecting the profits of the present contract which they have made, and respecting any future contract, or any future sale or disposition or sale of machinery which they may make before the matter comes on again, giving liberty to both parties to apply, and referring the consideration of costs.



The wheel of Cavé, alluded to in the course of these proceedings, differs from that of the Messrs. Seawards in no other respect than in the manner of attaching the feathering-rods to the float-boards. Cavé's method is shown in the subjoined diagram A; the improved arrangement of the Messrs. Seawards in the diagram B.

M. DUFRENOY'S REPORT ON THE USE OF HEATED AIR IN THE IRON WORKS OF ENGLAND AND SCOTLAND.

(Concluded from p. 262.)

It results from the preceding description, that certain coals, those of Wales, are employed in their natural state, for the fusion of iron ore in the smelting furnaces in which combustion is sustained by cold air.

That a great number of others—the coals of Glasgow, for example—are also susceptible of being used in the crude state, when the hot blast is employed; but that, for some varieties, the transformation into coke appears still to be indispensable, whatever be the plan on which the iron is made. To appreciate the causes which produce these remarkable differences in the properties of these coals, I have collected samples of most of those employed in the works spoken of in this report, which M. Berthier has analyzed in the laboratory of the School of Mines, and the results of which he has communicated.

Coal employed in the Crude State in the Welsh Iron Works. Cold Blast.

	Dowlais.	Cyfartha.	Pen-y-danau.
Carbon,	0·795	0.784	0.768
Ashes,	0.030	0.028	0.032
Volatile matters,	0.175	0.188	0.200
	1.000	1.000	1.000

The coal of Dowlais is lamellar, separating across the layers in smooth and brilliant plates. This coal is composed of two distinct parts, one brilliant, dividing into small cubic fragments; the other, completely hard, fracture conchoidal, is nearly analogous to the Cannel coal.

These two varieties do not blend, but form in each strata small beds of greater or less thickness; the brilliant part greatly predominates. The Dowlais does not soil the fingers; it swells very little in coking, and does cake; the ashes are perfectly white.

The coal of Cyfartha is rather slaty, or lamellar, but is composed, as the preceding, of the union of the brilliant and compact black parts, intimately mixed, like the quartz and feldspar crystals in granite.

These two varieties of coal act very differently; that having a brilliant fracture swells and cakes sufficiently, whilst the dull kind is dry, and does not change by exposure to the fire. It is probably this mixture that gives to the coal employed at the Cyfartha works, the property of resisting more than any other the action of the blast, and the different movements which take place in the furnace; its friability is also due to this cir-

cumstance; but the bitumen, which exists in sufficient abundance in the shining coal, cements the different parts of this coal, and gives it a great solidity after having been exposed to the fire.

The coal of Pen-y-danau has the same properties as the preceding, except that the mixture of the two kinds is less intimate. These three coals, belonging to the coal-basin of Wales, are very dry, and owe this property to the excess of carbon which they contain; they are analogous to the coal of Rolduc.

Coals employed in a Crude State, in Furnaces worked with Heated Air.

		Environs of Glasgow.			Stafford-shire.	Derbyshire.	
		Clyde.	Calder.	Monk-land.	Tipton near Wed'y.	Butterly.	Codnor Park.
Carbon,		0.644	0.510	0.562	0 675	0.570	0.515
Ashes,		0.046	0.040	0.014	0.025	0.030	0.030
Volatile matters,	Water,	0.005	0.039	0.115	0.300	0.400	0.455
	Gas,	0 139	0.081	0.094			
	Tar,	0.166	0.330	0.215			
		1.000	1.000	1.000	1.000	1.000	1.000

The coal of the environs of Glasgow, employed in the Clyde, the Calder, and the Monkland works, present characters sufficiently marked, and of a composition very analogous, as seen by the preceding table.

This coal is usually dull, a little compact, hard, and does not crumble between the fingers; it presents, in its transverse fracture, a series of small lines, which gives a slaty appearance, though it does not, in reality, possess this quality. It is very well stratified, and the lumps cleave in flat fragments, of greater or less thickness; the surfaces of separation are almost always marked by black carbonaceous matter, which soils the fingers, and resembles charcoal in its fibrous appearance, and dull colour.

This coal is often traversed by extremely thin fillets of carbonate of lime, the direction of which is perpendicular to the layers, and sometimes pyrites is found.

The pieces of Glasgow coal submitted to analysis, softened but slightly; they cement together without change of form.

The coal of Tipton, which supplies the works of Lloyd and Forster, near Wednesbury, is slaty; it is composed of small beds, a few lines in thickness, separated almost always by an extremely thin bed of black carbonaceous matter, like charcoal. This substance is so abundant, that a piece of coal is rarely found at Tipton, more than four inches thick, which does not present one or two layers of this friable material. This coal, shining in its fracture, divides into small pseudo-regular fragments; it is slightly tenacious, and swells but little in coking.

The coals in the environs of Derby are divided into two principal qualities, designated under the names of Cherry coal and Soft coal; the first, which is the harder, resists the action of the fire better than the second. The furnaces of Butterly, which use heated air, consume the Cherry coal exclusively; this coal is slaty, and presents lines of dull black, which gives it a strong resemblance to the coals of Scotland.

The soft coals, employed principally for steam-engines, and puddling furnaces, are used also, at Codnor Park, for the roasting of ores. This coal is shining, slaty, and separates in pieces by very light pressure; it contains some thin portions of black and friable carbonaceous matter, already alluded to.

Notwithstanding the considerable loss which these two coals sustain by coking, they scarcely change their form; they swell and cake slightly, and their ashes are perfectly white.

Coals that appear to require transformation into Coke, when employed even in Furnaces worked with Heated Air.

	Birtly Works, near Newcastle.	Tyne Works, Northumberland.	Apdale Works, near Newcastle, Staffordshire.
Carbon,	0.605	0.675	0.624
Ashes,	0.040	0.025	0.035
Volatile matters,	0.355	0.300	0.341
	1.000	1.000	1.000

The coal consumed at the Birtly and the Tyne Iron Works, comes from the mines in the environs of Newcastle-upon-Tyne; it is shining and splintery; it does not soil the fingers, nor does it crush by a light pressure.

This coal is, in general, very pure, containing no veins of carbonate of lime, or pyrites; it is very adhesive, and swells much by the action of heat, so that the value of the coke exceeds that of the coal employed. I am assured at the Tyne works, that they have tried in vain to work Newcastle coal in the crude state.

The coal of the Apdale works is lamellar, shining and splintering in the direction of the strata; it divides into small quadrangular fragments; in the cross fracture it presents large bands, perfectly smooth, and very brilliant. This is owing to the superposition of small layers, of which the nature is a little different; this coal is very adhesive, swells in the fire, and gives a light, silvery, but very solid, coke.

If we compare the composition of the different coals that we have examined, we perceive—

1st. That the coals employed in a crude state, in the furnaces worked with cold air, are dry, very carbonaceous, and, in fact, true anthracites.

2d. The coals, as those of Scotland and Derbyshire, which, though bituminous, serve, in a crude state, for the fusion of iron ore in the smelting-furnaces worked with heated air, are, however, still dry coals.

3d. Finally, the fat, bituminous, adhesive coals, which change their volume, and swell by the action of fire, appear stlll to require a transformation into coke, to give advantageous results in the smelting of iron ore.

Quality of the Pig Iron and Bar Iron obtained in the Works using the Heated Air Blast.

The iron for castings made in Scotland, bears a less commercial value than that of Staffordshire. The first were quoted in the Liverpool market, in the month of July (1833) last, at 4*l.* 15*s.* sterling per ton, whilst the Staffordshire iron sold, at the same time, for 6*l.*

The difference between the price of these kinds, together with the prejudice generally entertained that the hot blast is unfit for the manufacture of iron, led some to doubt the advantages to be derived from the new method. The numerous observations I have made, tend, on the contrary, to prove that, for cast-iron, at least, the products of the furnace working with heated air, are superior to those of the cold blast. The less value of the Scotch iron is no evidence against this opinion. In fact, the Staffordshire iron has always been regarded as the most suitable for castings, and has always borne a higher price than that from most of the other parts of Great Britain; perhaps, also, the great difference in price between the Scotch and Staffordshire irons, may be accounted for by commercial circumstances, for the Scotch now make iron much cheaper than others, and the production being increased almost one-third by the employment of heated air alone, the iron-masters have thought it to their interest to reduce the price of their iron, which they are enabled to do without loss.

It would be desirable if this important question could be decided by direct experiments; but, for want of such, I will state the uses of these different products in the arts—uses which are, perhaps, as conclusive as experiments.

In the works near Glasgow, they make iron only for the foundry; I have seen the iron which they produce employed for the manufacture of castings, which require great strength and softness, to wit, steam-engine cylinders, boilers, gas-pipes, mill-gearing, &c.

At Birtly, near Newcastle, and at Butterly, near Derby, I have also seen steam-engine cylinders, pipes for water-pumps, and fastenings for iron bridges.

I should state that the furnace of Torteron, at the Fourchambault works, in the Nievre, produces, since the use of this plan, grey iron, which competes in the market with that from England.

The iron manufactured from hot-blast pigs, is also of very good quality.

At Codnor Park, near Derby, this iron is employed in the construction of different parts of the steam-engine, of chains for suspension-bridges, and of straps and cross-bars in iron bridges.

The iron produced at the Tyne works is wrought into sheets, for steam-boilers, gasometers, &c.

At Wednesbury, the iron is also of good quality, and serves for purposes which require great strength.

These different examples prove that, by means of the hot blast plan, as well as by the old mode, superior metal can be made for foundry purposes, and which is well adapted for conversion into wrought iron; but it must not be thought that, by means of this plan, the faults which result from the nature of the ore, or coal, can be corrected.

Probable Causes of the Increase of Heat, due to the Use of Heated Air.

I have remarked several times, in the course of this Report, that the temperature of the furnaces worked with heated air appears to be higher than in those where combustion is sustained by the use of cold air; all the indications which are usually considered as

guides for the working of the furnace, unite in proving this assertion.

The scoria does not attach itself above the tuyeres; the colour of the fire, in this part of the furnace, is so white as to be injurious to the eyes; the scorias, which are very liquid, flow with facility; the metal being hotter, can be cast directly into the most delicate objects. The quantity of ore in each charge is augmented in a great proportion, whilst the quantity of flux is decreased. This diminution in the proportion of melting is, of itself, the strongest proof of the increased temperature of the furnace; it indicates to us that the earthy matters find sufficient heat to fuse with a small addition of flux.

Probably it is to this excess of temperature that we should attribute the faculty of employing certain coals in a crude state, the transformation of which into coke appeared indispensable, at a less elevation of temperature.

In spite of these certain proofs of the increased temperature by the introduction of hot air into the furnaces, we cannot demonstrate its existence in a positive manner; but it appears to me that, to a certain point, a reason for this phenomenon may be given, by comparing that which passes in the furnace, by the constant introduction of air, to that which takes place by the mixture of two liquors of different temperatures, which we know will produce a mean temperature. The comparisons which I establish appear to me to be just, though the furnaces are in circumstances very different from the liquids having a given temperature, because the heat is reproduced without intermixture, by the combination of carbon and oxygen.

By admitting this cause of the augmentation of heat, it might be supposed to be very slight; on account of the great difference which exists between the temperature of the furnace, and that of the air which sustains the combustion; a difference that we have no accurate means of appreciating. I will show hereafter that this cause is not so feeble as might at first be supposed.

There is, I believe, another much more powerful cause, which it is impossible to estimate; it results from combination, which could not be produced at the ordinary temperature of the furnace, and which are developed by the augmentation of heat due to the substitution of hot for cold air.

We see constantly, in our laboratories, examples of this phenomenon; substances which are acted upon slowly, and with much difficulty, by acids, at the temperature of the atmosphere, dissolve with facility when the liquor is slightly heated, and the combination formed often becomes itself a powerful source of heat. The operation of the smelting furnaces presents to us, perhaps, similar circumstances. The bitumen, and certain gases, which cannot burn at the temperature of the furnace using cold air, becomes ignited by the feeble augmentation of heat produced by the introduction of heated air; and the little smoke which passes out from the trunnel-head when crude coal is consumed, and also the colour of the flame, authorises the belief that the bitumen, the hydrogen gas, &c., are almost wholly consumed.

This supposition naturally answers the objection that may be made, that, even admitting a certain augmentation of temperature by the introduction of heated air, there can be no diminution in the quantity of fuel consumed, because the diminished amount of fuel used in the furnace is compensated for by that required to heat the air.

We have stated that the quantity of air injected into the furnace, could, by its great mass, have the power of cooling it to a considerable degree.

This mass of air was raised in the Scotch works, before the adoption of the hot-air plan, to 2,800 cubic feet per minute, weighing 214¼ pounds. The quantity of air injected in each day, therefore, may be estimated at about 140 tons.

The total amount of coal, mineral, and flux, does not exceed 34 tons; the weight of air, therefore, injected into the furnace, is more than four times that of the solid materials used in the same time.

We may conceive, therefore, that so considerable a mass, of which only a fifth part sustains combustion, thrown into the furnace at the mean temperature of the atmosphere, will produce a much greater refrigeration than when raised to the temperature of more than 600 degrees.

A circumstance which still tends to diminish, in a great degree, the refrigerating power of the air, by the use of the new plan, is, that the quantity of air is much less. In the furnaces of Scotland that we have taken for example, the quantity is reduced from 2,800 cubic feet, to 2,100 per minute, or 25 per cent.*

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* The specific heat of water being represented by 1.0000, that of the atmospheric air is 0.2669, from which it results that a gramme of air at 322° cent., (612° Fah.) the temperature at which the air is injected into the Clyde furnace, would raise 0.733 gms. of water to 100°, (212° Fah.) supposing the air reduced to 10°, (60°;) and as the quantity of air introduced each minute is, 124,779 gms.; the heat which results from this mass is represented by 91,463 gms. of water, raised to 100°.

The charges at the Clyde works are now 34,416 kilogrammes of coal in 24 hours, or 23.90 kil. per minute, which, after deducting the waste by ashes, water, and gas, which escapes without being burnt, may be taken at a maximum of 20.30 kil.; the complete combustion of this quantity of coal would raise, in each minute, 1,465 kil. of water, from 0 to 100° centigrade; the increase of temperature which results from the temperature of the air at 322°

We can calculate the influence of the introduction of air upon the heat developed each instant, by the combustion of carbon; but it appears impossible to appreciate the augmentation which results from new combinations, caused by the combustion of the bitumen and carburetted gases, because we cannot, in the present state of the science, estimate the temperature in the interior of the furnace; the few observations that precede, though not giving any idea of the real influence of the heated air, appear to me, at least, to establish that it is very considerable.

Recapitulation.

The details into which I have entered upon the greater part of the works using heated air, have, perhaps, prevented the reader from seizing the principal circumstances of the plan; I deem it, therefore, useful to recapitulate briefly—

I. In all the works, with the exception of one or two, its introduction has resulted in an increase of the products, an economy in the consumption of fuel, and of flux, as well as in the expense of labour, and incidentals.

II. These advantages have followed in the same progressive ratio as the temperature to which the air has been heated.

III. The production of metal has generally increased.

IV. The quantity of combustible matters burnt in the furnaces, appears to be nearly the same where the heated air is used, as before with cold air; the daily consumption at the Clyde being 18 tons of coke, to obtain 6 tons of metal; now it is 18 tons of coal, to produce 9 tons of metal.

V. The metal produced in the furnaces worked with heated air, is generally grey, and fit for the foundry; nevertheless, this plan is employed with advantage in the works of which the pig-iron is all, or in part, manufactured into bar-iron (Codnor Park, Tyne, Wednesbury, &c.) It is only necessary, for this purpose, to change the proportions of ore and fuel.

VI. In many works, the combustion requires much less heated than it did cold air; at the Clyde, for example, the same blast-engine which served with difficulty for three furnaces, now blows four. The economy in motive-force is not proportional to the diminished quantity of the blast, because a certain power is required to overcome the friction of the air in the heating apparatus, and the resistance which results from the expansion of the air by the heat. This last inconvenience is remedied by increasing the size of the tuyeres, their diameter having been increased from two and a half to three inches; the increased diameter of the tuyeres is also necessary to diminish the velocity of the current of air, when introduced into the furnace.

VII. When, as at Torteron, a diminution in the quantity of air does not result from increasing the temperature, additional power is required to move the blowing-machine.

VIII. The substitution of heated for cold air, in the fusion of iron ore, is marked almost immediately by a change in the nature of the metal, which becomes more carbonised; the charges descend more slowly, but the working is accelerated by augmenting the proportion of ore.

Relative to the Apparatus.

IX. The apparatus formed by joining pipes of large diameter, which receive the air, and of small pipes, in which it is heated, and dilated, appears to me to be preferable to that composed of a series of pipes, of great diameter; requiring a smaller space, being less costly in the construction, and consuming less fuel than the last-named; besides, the temperature is not uniform in all parts of this apparatus, and a current is usually formed in the centre, of diminished temperature.

X. To diminish, as much as possible, the velocity of the air submitted to the action of the heat, and to avoid the resistance due to its expansion, it is necessary that the surface of the small pipes should be more extended than that of the large pipe which receives the air from the blowing-machine.

XI. The interior capacity of the small tubes ought to be greater than the volume of air injected into the furnace; by this disposition, the air remains a longer time exposed to the action of the heat, and acquires a more elevated temprature.

XII. From this last condition, the apparatus placed on the trunnel-head appears to be of but little advantage to furnaces using coal; sufficient size cannot be given to it, to enable the air to remain long enough; to remedy this evil, the air is made to pass over another fire placed near the tuyere.

Relative to the Fuel.

XIII. The coals, very rich in coke, which are dry, and resemble anthracite, can be employed in a crude state, in furnaces working even with cold air.

XIV. The coals which contain a large proportion of volatile matters (30 to 35 per 100), but which are not very adhesive, and do not change form during combustion, serve, without being carbonised, to work in furnaces using air heated to 300° cent.

XV. It appears, finally, that fat and bituminous coals, like those of Newcastle, which are fit for the fusion of iron, must, even with the hot blast, be transformed into coke.

cent., compared with that produced by the combustion of coal, would be as 92 to 1465, or one-sixteenth. This is the least ratio, the quantity of oxygen being insufficient to transform all the carbon into carbonic acid.

DESCRIPTION OF A PORTABLE PRINTING PRESS.

Fig. 2.

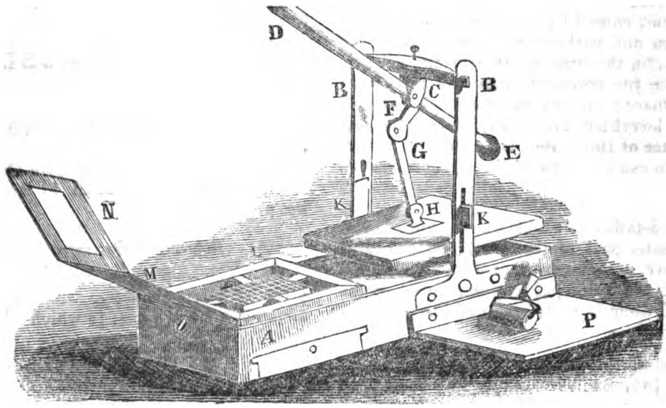


Fig. 1.

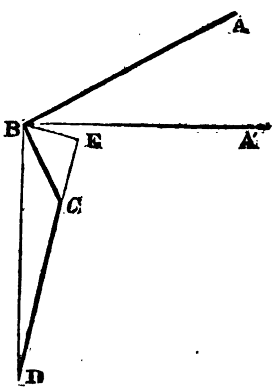
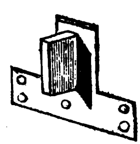


Fig. 3.



Sir,—Having been led by circumstances to attempt the construction of a printing-press, which should combine the properties of simplicity, cheapness, and portability; and having succeeded therein to the utmost extent of my expectations, the following description may perhaps not be unacceptable to your readers. I shall first explain the principle I have employed, and then describe the construction by which I have endeavoured to adapt that principle to the purpose required.

A B C, fig. 1, is a lever, bent into a right angle at B, at which point it moves on an axis as a fulcrum. To the extremity, C, a piece C D is united by a joint at C, and the lower end of which, D, is confined to move in the straight line B D. Now, if any power, as the hand, be applied at A, so as to bring B A into the position B A′ (B A′ being drawn at right angles to B D), it is plain, that the effect will be to bring B C and C D into the same straight line, and, consequently, to depress D.

To calculate the relation that subsists between the power applied at A and the ultimate force exerted at D, produce D C to E, and let fall B E perpendicular thereto. Now, calling the forces at A, C, and D, P, P′, and W, respectively, we have,

$$P : P' :: BE : BA \quad . \quad . \quad . \quad . \quad (1)$$
$$\text{and} \quad P' : W :: BD : DE$$

Or, substituting in the second analogy the equivalent of the ratio, $BD : DE$,

$$P' : W :: \text{rad} : \cos BDC \quad . \quad . \quad . \quad . \quad (2)$$

Wherefore, compounding (1) and (2), and calling $\text{rad} = 1$,

$$P : W :: BE : BA \cdot \cos BDC \quad . \quad . \quad . \quad . \quad (3)$$

Now, by trigonometry, $BE = BC \cdot \sin BCE = BC \cdot \sin (BDC + CBD) = BC (\sin BDC \cdot \cos CBD + \cos BDC \cdot \sin CBD)$.

Hence, substituting in (3),

$$P : W :: BC (\sin BDC \cdot \cos CBD + \cos BDC \cdot \sin CBD) : BA \cdot \cos BDC.$$

And dividing by $BC \cdot \cos BDC$,

$$P : W :: (\tan BDC \cdot \cos CBD + \sin CBD) : \frac{BA}{BC}$$

$$\text{Or,} \quad P : W :: (\tan BDC + \tan CBD) \cos CBD : \frac{BA}{BC}$$

$$\text{Finally,} \quad P : W :: \frac{BC}{BA} :: \frac{1}{(\tan BDC + \tan CBD) \cos CBD} \quad . \quad . \quad . \quad (4)$$

We see hence, that P being constant, W varies as a function of the angles CBD, BDC, viz. as, $\frac{1}{(\tan BDC + \tan CBD) \cos CBD}$.

Let us examine, therefore, what change takes place in this expression in consequence of a diminution of the angle ABA' by BA being depressed. We observe, then, that the denominator consists of two factors, of which the first (being the sum of the tangents of two angles, each of which is less than a right angle), decreases without limit, and becomes $= 0$ when BA coincides with BA'. The remaining factor, on the other hand, increases with the diminution of the angle ABA'; but its increase is limited by unity, which value it reaches when ABA' vanishes. Therefore, the value to which the expression approximates as ABA' decreases, is $\frac{1}{0}$, or ∞; and, consequently, the ratio of $P : W$ continually approximates to that of $\frac{BC}{BA} : \infty$, that is, the power applied at A, exerts at D, by the diminution of the angle ABA', a continually increasing force; and this increase is without limit, for by sufficiently diminishing this angle, the force at D may be made greater than any that can be assigned.

We have here, however, made no allowance for friction, and the imperfect rigidity of the materials employed; and it is found in practice that these causes set bounds to the increased referred to long ere the attainment of such a force as that just mentioned. The latter of these causes, moreover, renders the exertion of some degree of power necessary to release the lever BA from its position after the pressure has been given. It is, therefore, found expedient not to reduce the angle ABA' below a value of from 3° to 5°; and to seek any further degree of force that may be necessary by other means. An examination of the formula in (4) shows that this is to be done either by increasing P or by diminishing the ratio of BC to BA and CD.

It is considered a desideratum in all modern printing-presses, that the same power shall exert a continually increasing force;* and as we have seen that the principle demonstrated above furnishes us with such a force, it is evident, that if we can apply it properly it is suitable for our purpose. I proceed, therefore, to describe the press I have constructed, premising, that it is on a very small scale (just sufficient to print an octavo page),

* The reason of this is, that in order to afford room for the necessary motions and adjustments, the platten requires to move through a considerable space. This condition cannot be fulfilled by any ordinary combination of levers (or any other of the mechanical powers) without, at the same time, making it needful for the motive-power to pass through a space inconveniently great. Now, by such an arrangement as the above, in which the advantage gained is least when the platten meets with no resistance to its descent, and reaches its maximum only when the platten comes in contact with the face of the types, a greater space is on the whole described by the platten than would be the case were the force uniform throughout, and equal to that which is required to produce an impression.

yet large enough to test the accuracy of the principle.

A, fig. 2, is a strong frame of wood, 21 inches long, 9 broad, and 4 deep, to which are attached, by means of screws, and a bolt which goes completely through the frame, and is fastened with a nut on the opposite side, the two cheeks B B. These cheeks are of wrought-iron, 1½ inches broad, and ⅜ths thick. They are connected at top by a strong iron bar, the ends of which are fixed into mortices in the cheeks. This bar is at the ends about the same breadth and thickness as the cheeks, but increases in thickness towards the middle for the purpose of allowing to be rivetted to it two pieces, C, between which, upon an axis passing through them, the lever D E moves. Another object served by the thickening of the connecting bar is to allow of the insertion of a screw Q, of which the part that projects under the bar, and with which the prolongation of the lever D C comes in contact, by being lengthened or shortened has the effect of regulating the pressure to be given, according to the nature of the *matter*. An iron plate is screwed to the under surface of the lever D E, to which the piece F, also of iron, 1 inch broad and ¾ths thick, is rivetted. To the lower extremity of the piece F a bar G, ¾ths of an inch broad and ¼th thick, is attached by a rule-joint. G is united at the other end by a similar joint to a plate H, which is screwed to the top of the platten. The lengths of F and G, reckoning from the centres of motion, are 1½ and 3½ inches, respectively. The platten is of wood, 1½ inch thick, having screwed to its under surface a plate of cast-iron, ground very flat; and is preserved in its position, and confined to move parallel to itself, by guides K K, which pass through grooves in the cheeks, having just room enough to move freely without shake. These guides are of the form shown in fig. 3; and it is necessary to observe in regard to them, that the parts which pass through the cheeks must be so adjusted as to height, that a line drawn through the centre of motion at H, parallel to the surface of the platten, shall pass through a point in each, equally distant from the top and bottom. If this be neglected, these parts will be strained and liable to be twisted. L is a box, 10 inches long and 8½ broad, which answers the purposes of *chase* and *carriage*. The sides are 1 inch thick; such a degree of strength as is thus acquired being necessary to resist the pressure created in *locking up* the *matter*. Its depth is adjusted to *type height*; and the bottom is about half an inch thick. It slides upon the frame A, being confined by a rim, about half an inch high, which goes round the latter; and it is drawn from under the platten by a small knob, represented at O. M is the *tympan*, and N the *frisket*, attached to the box in the usual manner. P is the *inking-table*, composed of a plate of cast-iron, imbedded in a frame of wood. It is fixed to the frame A by two thumb-screws. When not in use these screws are withdrawn, and the table turned round and pushed into a groove fitted to receive it, where it is again secured by the same screws. At A is a drawer for holding *furniture*, &c. At E is a weight to raise the platten after the pressure has been given, and keep it suspended. The part D C, of the lever D E, should be of such a length, as, when brought into a horizontal position, not to extend beyond the end of the frame A; otherwise, when a heavy pressure is applied at D, the whole will be liable to be overturned. In the present case, D C is 16 inches long. The height of the cheeks B B should be such that the requisite pressure may be given a little before D E comes into a horizontal position. Any small error in this respect may be rectified by either planing down, or pasting folds of paper upon, the bottom of the box L.

It will be observed, that the object gained by the employment of a lever, in the position described above, for working the press, is portability, as in any other position of the lever the press would require to be fixed.

The mode of operation of this press will now, I believe, be tolerably clear; yet, to prevent misconception, I shall endeavour briefly to describe it. We shall suppose the *matter locked up* in the *chase*, or box, L, and the *inking-table* secured in its proper situation for working. The first thing to be done is, to put a little ink upon the table. Having distributed this equally with the roller, the workman lifts the *tympan* and *frisket*, and passes the roller over the face of the types in the usual manner. A piece of paper is then put upon the *tympan*, and this, together with the *frisket*, turned down upon the types. The box is now

pushed under the platten, and the lever pulled down till brought to a stop by the screw A. The lever is again raised, and the box withdrawn by the knob O. This process is to be repeated till the number of impressions required are obtained.

Resuming the expression (4), and fig. 1, we find the following value of W;

$$W = P \times \frac{BA}{BC} \times \frac{1}{(\tan BDC + \tan CBD) \cos CBD}.$$

Now, here $\frac{BA}{BC} = \frac{16}{1\frac{1}{2}} = \frac{32}{3} = 10{\cdot}66$, and we may assume for P what we please. The last factor, therefore, is the only variable one, and its variation depends solely on that of the angle C B D, or A B A′, the other angle, BDC, being a function of this, and of the sides, BC, CD, which are given, and equal to $1\frac{1}{2}$ and $3\frac{1}{2}$ respectively. If, therefore, we wish to know the actual power of this press, and also the increase of power consequent upon a diminution of the angle A B A′ or C B D, we shall have to substitute in the above expression the values of P and $\frac{BA}{BC}$ for these quantities, and likewise to give successive values to C B D. The results will be the values of W, or the power exerted by the press, for each particular value of the angle C B D; and the differences of these results will be the increase corresponding to each diminution of that angle respectively. However, as W varies, *for the same value of CBD*, directly as P, it is evident, that if we call P 1 pound, we shall be able, simply by multiplying the value of W, obtained on that supposition by any number assumed for P, to find the value of W corresponding to that value of P. Calling P 1 pound, then, and substituting for $\frac{BA}{BC}$ its value, the expression becomes,

$$W = \frac{10{\cdot}66}{(\tan BDC + \tan CBD) \cos CBD}.$$

The following table exhibits, in the first column, a few assumed values of the angle CBD, decreasing by 5°, except in the last case, where the decrease is only 2°; in the second, the values of W corresponding to these values of C B D, when P = 1 pound; and in the third, the increase of the power per cent., consequent upon each diminution of the aforesaid angle.

Values of C B D.	Values of W, in Pounds.	Increase Per Cent.
25°	18·03	
20°	22·14	22· 8
15°	29 07	31· 3
10°	42 16	45·03
5°	85 61	103 03
3°	226·18	164· 2
&c.	&c.	&c.

We here see that while, when C B D is 25°, a diminution of 5° occasions an increase in the value of W of 22·8 per cent.; a diminution of only 2°, when C B D is 5°, occasions an increase in that value of no less than 164·2 per cent. Also, if we desire to know the absolute power of the press when P is, say 20 pounds, and the angle C B D, 3°, we find 226·18 × 20 = 4523·6 pounds.

There are, as has been already stated, certain deductions to be made from the results in the second column, on account of friction and the imperfect rigidity of materials; and these deductions increase as we diminish the angle C B D. Since, however, they may be indefinitely reduced by careful construction, it is unnecessary to calculate them, if indeed that were possible.

I have said that the performance of this press answers my expectations; I send you some specimens, that you may judge for yourself.

I am, Sir,
Your obedient servant,

Q.

Aberdeen, July 16, 1835.

[The "specimens" which our ingenious correspondent has been so good as to send us of his press, do it great credit. *We* have seldom the good fortune to see such *proofs*. There is one—a portrait in wood of Erasmus while reading—which is particularly good.—Ed. M. M.]

INSTITUTE OF BRITISH ARCHITECTS—HUNTER'S STONE-PLANING MACHINE.

The last ordinary meeting for the season of this flourishing Institution was

held on Monday last, Earl de Grey, the president, in the chair

Mr. Papworth, V. P., read a paper "on the benefits resulting to the manufactures of the country from a well-directed cultivation of architecture and the art of ornamental design, as an essential portion of its study."

Mr. John Britton offered some observations upon the style of Domestic Architecture prevalent in England from the time of Edward IV. to that of James I., illustrated by numerous drawings of old mansions of that period.

A Memoir was next read on the value to Architecture of the Stone-planing Machine, lately invented and patented by Mr. James Hunter, of Leysmill, Arbroath (noticed in Mech. Mag., present vol. p. 73.). From this me t appears that the distinguishing features of Mr. Hunter's invention are,

1st. That the rough surfaces of blocks of stone are subjected in an intermitting succession to the operation of the planing machine; the blocks being removed as they are finished at one end of the machine, while new blocks are supplied to it at the other.

2d. That the planing tools can be readily adjusted to *any thickness of surface*, which may be required to be cut away.

3d. *That the greater the thickness of surface, which the tools are employed to cut away, the greater is their efficiency, and the less they are injured.*

And, 4th. That the tools are so firmly yet temporarily secured in their places, as to perform their office without *any appreciable shaking or recoil*, while, at the same time, they can be easily removed as they are worn, either for the purpose of repair, or of being replaced by new tools.

The principle on which the third of these advantages, the greatest and most startling of the whole, is obtained, was explained in this way. When the stones are placed ready for planing, the roughing tools, as the two which come first into action are called, are so adjusted that they shall strike each block as it passes under them, *at such a depth below the top surface*, as to sever and throw off before them large portions of the stone at a time, taking care always that the depth shall be within such limits as that the line of least resistance shall terminate in the top surface of the stone, so that the fractures shall all tend in that direction. Hence, the greater the thickness of stone cut away, the greater is the advantage, inasmuch as the lengths of stone severed and thrown off at each shake, are always proportional to the depth of the cutting, and, in like manner, the rest allowed to the tools, and their consequent exemption from beating and abrasion, is proportional to the lengths of stone separated from the surface at each stroke. For example, the wear of iron is less by, perhaps, one-half in taking off an inch at a time than in taking off half an inch; and to take off an inch of stone in two operations, will go far to quadruple the loss of iron.

The number of tools employed is only four—the two roughing ones just mentioned, which are round and pointed, and two finishing ones with broad mouths. In a late patented (but we believe abortive) machine of this description, the number of tools amounted to nearly forty. When a stone has passed under the roughing tools, the surface is commonly left in ridges, and these ridges it is the business of the finishing tools to clear away. The facing given to the stones by the new operations is so smooth, and, at the same time, so sound, that they can be afterwards polished for one-half of what it costs to polish stone prepared for the purpose by hand.

From calculations given in the Memoir, it appears that the cost of planing a superficial foot of Arbroath stone costs only *four-tenths of a penny*; while to do the same work by hand, would, on the very lowest estimate, cost four times as much.

The Arbroath stone is particularly fitted for street-pavement and stone-flooring. It resists damp much better, and dries more quickly than the Yorkshire flag. Slabs of it dressed of an equal thickness, and polished on both sides, can now be supplied in London for about ninepence per foot. In Scotland this sort of stone is now getting into extensive use as a substitute for marble; when painted in imitation of scagliola and well varnished, it is pre-

ferable to scagliola, and not half so expensive.

Mr. Hunter's machine, when coupled with a lathe, is capable of turning as well as planing stones. A very satisfactory proof of this was exhibited on the table of the Institute. It was a handsome vase presented to the Institute by Mr. Carnegie, the proprietor of the Leysmill quarries, 20 inches high and 18 across the mouth, which was turned out of the solid block by Mr. Hunter in the course of a single day's work; and is, in point of accuracy of outline and beauty of finish, worthy of all admiration.

Mr. Carnegie, who was present, said that he had no doubt that all stone of no greater hardness than the Arbroath, can by means of this machine be turned as fast, and nearly as economically, as wood. He would undertake that Mr. Hunter should diminish the diameter of a large grindstone a whole inch at one revolution, without materially injuring the tool employed.

GRAY'S RAILWAY SYSTEM.

Sir,—As the original proposer of the railway scheme, allow me to recal to the serious attention of your readers, the glaring error committed by the Liverpool and Manchester Railway Company, in the construction of their railway; which was pointed out by me in a circular published on the 1st of May, 1830 (see your Magazine of that time.)

Can there be any wonder at the indifference of the public with respect to railways, when we witness the wanton mismanagement of the railways hitherto established?

Every national benefit is sacrificed to *private* views, or to *particular* interests.

The speed with which passengers are conveyed is always blazoned forth, and kept up at a ruinous expense, merely to cover the ignorance of the engineers, who contrives to blind the public to the real advantages of railways worked by the double system of cog and plain rails —cog rails, for the exclusive conveyance of merchandise of every description, and plain rails for the express purpose of conveying passengers, mails, and light vehicles of every denomination.

Until these two systems become united, and adopted by the public, in the establishment of Grand Trunk Railways, in direct lines and on perfect levels, from London to each extremity of Great Britain, and from Dublin to each extremity of Ireland, as laid down in my numerous petitions to Government on this most important subject, depend upon it, sir, all present attempts at the formation of railways must ultimately terminate in disgrace to the engineers. All that has hitherto been done in railways, must be done over again ere the proprietors can find a sure and permanent revenue.

The Liverpool and Manchester Railway, notwithstanding the dividends, is a decided failure, which might be proved at any time. Truth and experience will break the seals of secrecy, and the bubble must then burst! Had this railway been constructed agreeably to my suggestion, the canal in that district would not have carried a ton of merchandise a week.

In one of my former letters I asked you, sir, if the proprietors of the Duke of Bridgewater's Canal had no interest in the railway? Give the railway fair play, and I am sure the rates of carriage and of fares might be reduced one-half.*

In some of the recent Numbers of your Magazine, I observe a series of letters signed "John Herapath." Pray, sir, is this the same gentleman who memorialised the Duke of Wellington in favour of Gurney's steam-carriage pranks on the turnpike-road, some years ago? By-the-bye, Gurney's in the field again!! so the papers tell us—*but where's the game?* A steam-carriage is the bait—but where are the gudgeons?

At the very time Mr. Herapath was addressing his Grace, I had also taken the same liberty; and herewith I transmit you, in part, a copy:—

"Every attempt to run steam-carriages on the common turnpike-road must, and ever will, prove both ineffectual and profitless; whilst the same engine would always, under all circumstances, propel *ten times the load more, and at a much greater speed, on railways!!*"

I perfectly agree with Mr. Herapath, that tunnelling is unnecessary; it is, however, a mania which, unfortunately for the purses of the deluded subscribers, has seized upon our *civil* en-

* This railway might certainly have been better constructed, and may, perhaps, be under some sinister influences, but to describe it as a "decided failure" is surely a decided mistake.—Ed. M. M.

gineers, who seem to be delighted in doing every thing to *blast* the success of railways. I really am much astonished that Government should so long refuse to listen to my petitions for the establishment of a National Railway Board in London, to superintend the construction of railways throughout Great Britain and Ireland, under one specific plan, without which every railway may vary according to the whim or fancy of different engineers.—Yours, &c.

THOMAS GRAY, Author of "Observations on a General Iron Railway."

NOTES AND NOTICES.

The gentleman of whom we spoke in our remarks on Lord Brougham's Patent Law Amendment Bill, as having been "Solicitor to the abortive Bill of 1833," and as having "no call, save his share in that abortion," to be one of the *select* triad who gave evidence before the *Select* Committee of the Lords, has written a letter to the *Times* journal, which did us the honour to copy our remarks, in which he says—"If the writer in the *Mechanics' Magazine* had furnished you with a copy of the Bill to add in the *Times*, as he could not avoid doing in the Magazine, to his observations, I think they would certainly prove as harmless, as in truth they ought to be." If it is meant by this to charge us with sending a copy of our remarks to the *Times*, and keeping back the Bill to which they referred, from an apprehension of its destroying the effect of these remarks—the language, indeed, admits of no other meaning—the writer has then a very gross misrepresentation to be ashamed of. Reason to suspect us of such disingenuous and unfair conduct, there was none, but on the contrary, good reason to be convinced that the reverse must have been the case. The *same number* of the Magazine which contained the *remarks* contained also a copy of the *Bill*. That the *Times* gave the one without the other, is no fault of ours; nor much fault in the *Times* either, if we may judge from the request with which the gentleman concludes his letter. One would have thought that it would have been a request to publish the Bill which he affects to regard as a complete answer to our remarks, but no - it is a request to publish "*my Evidence*"!!!

The *Times* having declined publishing "my Evidence," it has been since sent to ourselves with a request that it may be published in our pages. As we have no desire, however, to have our Magazine regarded as an asylum for rejected articles, we, too, must decline.

H.—We are not aware of any thing more recent.

To "A Looker-on." In one instance, but the trial was not a fair one, and the result therefore unsatisfactory.

D. P. H.—Much obliged.

Communications received from Mr. Baddeley—Rusticus—Mr. Alfred Canning—Mr. Ogle—Abbot.

LIST OF NEW PATENTS, GRANTED BETWEEN THE 22D OF JUNE, AND 25TH OF JULY, 1835.

William Crofts, of New Radford, machine-maker, for certain improvements in certain machinery for making figured or ornamented bobbin-net, or, what is commonly called, ornamented bobbin-net lace, part of which improvements are extensions of certain improvements for which Letters Patent have been granted to him, bearing date the 27th day of May, 1834. June 26; six months to specify.

Thomas Walker, of Burslem, mechanic, for improvements in extinguishers to candles, and in the application of such extinguishers to candles and candlesticks. July 3; two months to specify.

James Kean, of Johnston, county of Renfrew, machine-maker and engineer, for an improved throstle-flyer, or a substitute for an ordinary flyer, employed in spinning cotton, flax, hemp, wool, silk, and other fibrous substances. July 3; six months to specify.

Henry Vint, of London, in the borough of Colchester, Esq., for certain improvements in paddle-wheels. July 9; six months to specify.

Richard Coad, of Liverpool, manufacturing chemist, for certain improvements in the means or apparatus for consuming smoke and economising fuel in furnaces, which improvements are particularly applicable to the furnaces of steam-engines employed for navigation and other purposes. July 10; six months to specify.

William Busk, of Bankside, Surrey, engineer, for certain improvements in propelling boats, ships, or other floating bodies. July 10; six months to specify.

John Rogers, of Princes-court, Westminster, gentleman, for certain improvements in paddle-wheels. July 10; six months to specify.

Conrad George Kuppler, of Nuremburg, at the Polytechnical Institution, but now of Birmingham, for certain improvements in the construction of weighing machines, and other machines used in ascertaining weight. July 11; two months to specify.

Frederick Herbert Maberly, of Bourn, county of Cambridge, clerk, for a new method of propelling vessels. July 13; six months to specify.

Joseph Chesseborough Dyer, of Manchester, machine-maker, and James Smith, of Dunstone, county of Perth, cotton-spinner, for certain improvements in machinery used for winding upon spools, bobbins, or barrels, slivers or rovings of cotton, wool, and other fibrous substances of the like nature. July 17; six months to specify.

William Vickers, of Sheffield, merchant, for improvements in machinery, for preparing or shaping steel for the manufacture of files and rasps. July 17; two months to specify.

Joseph Henri Jerome Poittevin, of Craven-street, county of Middlesex, gentleman, for a powder which is applicable to the purposes of disinfecting night soil and certain other matters, and facilitating the producting of manure, being a communication from a foreigner residing abroad. July 17; six months to specify.

John Dickinson, of Bedford-row, Holborn, and William Long Tyers, of Apsley Mill, in the parish of King's Langley, in the county of Hertford, for certain improvements in the manufacture of paper. July 24; six months to specify.

Thomas Horne, of Aston, near Birmingham, brass-founder, for certain improvements in the manufacture of hinges. July 24; six months to specify.

Our Publisher will give One Shilling and Sixpence for copies of the Supplement to Vol. IX.

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No. 626. SATURDAY, AUGUST 8, 1835. Price 3*d*.

Fig. 1.

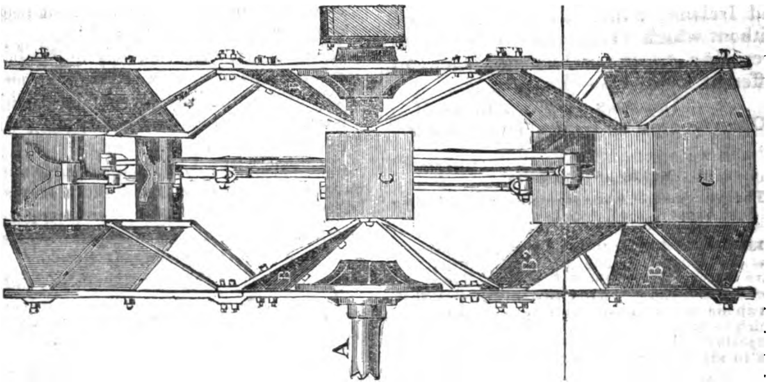
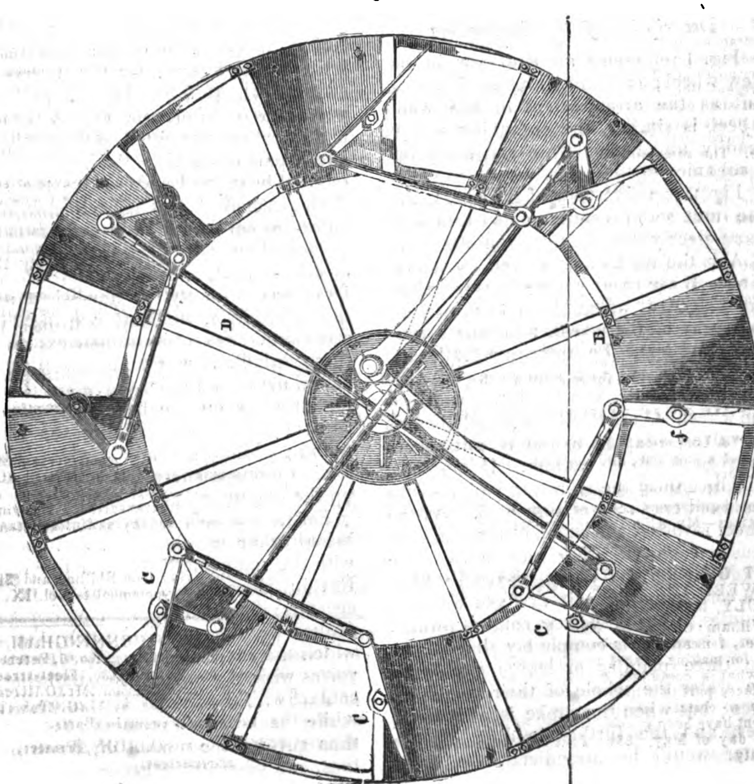


Fig. 2.



CARTER'S PATENT PADDLE-WHEEL.

DESCRIPTION OF THE PATENT PADDLE-WHEEL,

Invented by George Carter, Esq. of Mottingham Lodge, Eltham, Kent.

(Communicated by the Inventor.)

From the commencement of steam-navigation to the present time, upwards of fifty patents have been granted (so the writer is informed) for improvements in paddle-wheels, all of which are calculated, in the opinions of the inventors, to avoid the concussion and lift of tail or back-water of the old paddle-wheel, and consequent loss of power.

But the failure of nearly the whole of these inventions—either from their costly nature, complication of working parts, or want of strength when put to the test of head-wind and sea—has induced the inventor of the present modification to attempt a combination of the strength and simplicity of the common wheel with those peculiar arrangements which form the subject of his patent.

Description of the Engravings.

Fig. 1 represents an end-view of this new wheel; only the front half is seen, but as the arrangement of the whole wheel is similar, the engraving will be readily understood by every competent mechanic.

Fig. 2 is a side-view of the wheel, with the front set of boards removed, to show more clearly the interior arrangements.

A is the main-shaft driven by the engine. B are fixed paddle-boards, which are placed at an angle of 35° with the periphery of the wheel, and thus always enter and leave the water in a feathering position; a vacant space is left between each pair, one-third the width of the wheel. C are vibrating paddle-boards or valves, adapted to the vacant spaces between the fixed paddles. D are rods, which connect the vibrating paddles with the fixed crank or eccentric E. As the wheel revolves, the action of the eccentric causes each vibrating paddle to close gradually on the vacant space between the corresponding pair of fixed angular paddles, till at the lowest point of revolution this space is completely closed, and the three paddles or leaves oppose to the water the whole of their combined force; but when the stroke is, as it were, over, and the further holding of the water would be prejudicial, the same eccentric action draws back the vibrating paddle into a vertical position, and allows the back-water to escape between the fixed float-boards B.

The present wheel, it will be observed, is so constructed as to be quite as strong as the old or common wheel. The fixed angular paddle-boards, striking the water edgeways, are not so easily broken as the common paddles by a sea or floating timber, and a much larger surface of paddle-board may be made available in a propelling direction. The vibrating paddle-boards or valves, too, may be made to open at any part of the circumference, to diminish or add to the resistance, which will be found an advantage to a steam-boat working against a head-sea, by ensuring the regular speed of the engines.

The common paddle-wheels now in use may be altered to the present plan (without cutting the main-shaft) at a small expense; *and as the working parts form but a small portion* of the wheel, the cost for repairs will be moderate.

The inventor, to obtain true results, built a steam-boat, for the purpose of experiment, of 9 tons burden, and with an engine of 4-horse power. A common paddle-wheel was fitted to the starboard, and a patent wheel to the larboard, side of the boat, both wheels on the same shaft, and of 6 feet in diameter. The patent wheel had greatly the advantage in propelling power (free from concussion, or back-water), so much so, that when the helm was at liberty the new wheel made the outer circle, the boat working to the starboard. From the oblique position of the boards B, it was noticed during the experiments in a gale, that a sea striking forwards, or on the beam, appeared to assist the engine in driving the wheels round; while the common wheel, under similar circumstances, frequently brought up the engine to half speed.

For new wheels I prefer a fixed crank bolted to the paddle-beam, and dispense with the main-shaft through the wheel. But in altering old wheels, I use an eccentric fixed on a short, hollow shaft (bolted to the paddle-beam), through which the main-shaft is passed, and revolves with the wheel, without being in contact with the sides of the hollow shaft; while the eccentric remains at rest, and thus governs the motion of the driving-rods, and vibrating or centre paddles.

ON RAILWAYS. BY JOHN HERAPATH, ESQ.

NO. VIII.

Expense, &c. of obtaining the Parliamentary Sanction.

If ever one thing reflected more severely than another on the legislative justice of this country, and required the deep knife of reformation, it is the manner in which private Bills for great public measures are allowed to be resisted, and the enormous expense entailed on them in passing the two Houses of Parliament. Would any person, who had barely heard of our famed "Three Estates," and the boasted equity of our administration, who in neighbouring countries had seen all great works executed by the governments, imagine, that a measure, the utility of which to the community had been demonstrated by the experience of years, should not only not be carried by our Government, but that this Government should rather foster impediments by permitting outrageously long discussions on trifling and irrelevant matters, thereby incurring an expense injurious to the concern, unjust to the promoters, and, in certain instances, frightful to contemplate? Were some of the many absurd and unmeaning questions and answers in the Committees, having no bearing whatever on the merits of the case, to be published, the world would be surprised at the tame patience of our legislators in allowing their time, day after day, to be so occupied and wasted, while men of business would be astonished to learn, that every minute so consumed costs the promoters and opponents of the measure as much in some cases, I am informed, as 1*l.* or 2*l.*, or from 60*l.* to 120*l.* per hour; so that frequently 20*l.* or 30*l.*, that is as much as many a poor family has to support it for a whole year, are spent before a question and its answer can be completed, the sense of which it would be difficult to decipher, but the utility of which, I fear, it would puzzle all Europe to discover.

In round numbers, the following are the costs of a few of the late Bills as given to me by those who profess to have the means of knowing. The London and Southampton Railway Bill cost about 31,000*l.*, exclusive of the opposition to the Great Western; the Birmingham Railway, 90,000*l.*; the London Docks, 100,000*l.*; the Great Western, it is calculated, will fall little short of 150,000*l.*' whether the Bill be obtained or not. Hence the last Bill, including the expenses of opposition, may be set at least at 260,000*l.*; a sum which, at the foregoing rate, would feed, clothe, and house 10,000 poor families, or, allowing five persons to a family, 50,000 persons for a whole year; that is as many, if they were men standing in a row side by side, as would form a continued line of nearly 14¼ miles in length, and if touching hand to hand of about 52 miles, which is nearly the distance between London and Cambridge. Can so extravagant an expense be necessary? and if not, ought it to be permitted?

It is to be hoped, that something will be done to prevent in future this frightful waste of the subscribers' money, otherwise the dread of such an immense sacrifice may have the most baneful effects. In fact this, it seems, has already been the case. "Get your Bill," said some gentlemen lately, I am informed, to the Secretary of a projected railway, "and we will then take shares enough; but we are not going to subscribe our money to be squandered away in Parliamentary contests." Can any one blame this prudence and care? Who, for instance, with the prospect of spending 150,000*l.*, without the smallest conceivable advantage, and without even the certainty then of having their Bill, will think of subscribing to any measure, however profitable and beneficial it promises to be? Certainly none: but what will the end of this be? Is the progress of improvement to be entirely arrested? Are the interests of our manufacturers, the interests of our agriculturists, the interests of our commerce, in fact, are the vivifying and vital principles of this country to pine and to perish, because our legislators have suffered those adits of justice, which should be opened by benevolence, to be usurped by a devour-monster, that no one can approach without mischief nor pass without damage? That the members of the legislative Committees give their best attention and devote their time with the most praiseworthy zeal to investigating the merits of the cases, there can be no question. Every person who has attended the Committees must assent to this. But are not these Committees exposed to the grossest delusions and frauds? And are

not such daily practised on them by which the time is spun out and the expense terrifically increased? This, I believe, few will deny. The question, then, is how to prevent or avoid the evils? A railway-board has been suggested; but I confess I am very doubtful of the success of a scheme of this kind. It appears to me it would only be opening another field for private jobbing, robbery, and oppression; and would throw the whole welfare of the empire, as far as it depended on this new mode of conveyance, at the feet of one or two mercenary, despotical underlings; with whom the success of any measure would depend, not on what it is, but on what it brings. Bad as the present system is, every honourable mind would prefer submitting his plans openly to men who have characters to lose, to being at the concealed mercy of wretches of sateless cupidity, whose compass is interest and gold, the pole to which it points; who, from a little pique, or a *weightier* consideration, would not scruple to sacrifice the best and promote the worst of projects, though their country and all but themselves were to be entombed in the ruins.

Whatever view we take of the matter, it is deeply imbedded in difficulties. But it has occurred to me, that if the time for the promoters and opponents of a Bill was limited, the expense would necessarily be limited too; and it would thus oblige them to cull and concentrate the best, and reject the worst of their evidence. For instance, suppose a month was allowed as the maximum time for the passing of a Bill—a fortnight in each House. Surely a week in one House would be quite enough to establish all that is needful in favour of any measure, and a week all against it; particularly as the evidence might be varied or amended in the other House. Minor arrangements might easily be made; but if two days were allowed to examine the expediency of a line, two for the goodness of it, and one, as the members sit only five days in a week, for miscellaneous matter; and if the same were allowed against it, I presume it would be quite enough where business is the object.

But, probably, the most effectual means of all would be to make it a piece-work job for the legal gentlemen, giving them so much for the whole, and so much per cent. more if they attained their object. We should then have in law as in other matters, hours and pounds sterling incommensurable quantities. Cicero tells us he cannot conceive how two diviners, conscious of the tricks with which they juggle the public, can look each other in the face without laughing. For my part, I have often admired the command of countenance with which one counsel will gravely find fault with another in a Committee for eking out the time, and have thought how he must chuckle at his auditors' simplicity for believing him in earnest, knowing, as he does, that the longer the job the more profitable it is, and that every *minute* he is then so seriously exhausting in complaints, puts 1*s.* 6*d.* or 2*s.* into the pockets of himself and his brother sinner. "So I hear you have lost your Bill," said a gentleman to his learned friend. "Yes, we have," replied the other. "Must I condole with or congratulate you?" was the pithy rejoinder. What was the sur-rejoiner tradition hath not said, but as the learned gentleman lived to go into Parliament a second time, it seems the disappointment was not quite fatal to him.

I was in hopes of being able to add a few observations on the late lamentable accidents in the Watford tunnel, but my engagements for the present prevent me. The subject of this Number is, however, one of such great and growing importance, that, little as the time is which I have had to myself, I could not refrain from noticing it, in hopes it may attract the attention of some abler person, and at length lead to a remedy.

JOHN HERAPATH.

Kensington, August, 1835.

THE THAMES TUNNEL.

Sir,—I consider the numerous readers of your valuable journal must be highly pleased with your praiseworthy attempts at exposing the Thames Tunnel humbug; and I feel confident, that the frequent notices you have given of the manœuvres of its patrons, as well as the able and manly exposure of the Member for Berkshire upon the subject recently in the House of Commons, will completely stop the proposed misappropriation of 270,000*l.* of the public taxes, as proposed by Messrs. Hawes, Brunel, and Co.

This sum was to be applied in again

attempting to complete a work which (*if ever finished*) will only be a monument of folly and absurdity; for, after the public curiosity has been once gratified by a march through the tunnel, there it will end; for to suppose that waggons, or vehicles of any description, will ever use it as a means of transit, is to suppose that the proprietors' eyes are blind to their own interests, and open only to that of the Tunnel Company.

However, my immediate object in addressing you relates not so much to the present proceedings as to those which took place at the commencement of this business, when the public were so project-mad (if I may use the phrase) as to enter into any scheme, however absurd, provided only it was a Joint Stock Company.

At a great meeting which took place at the Crown and Anchor Tavern (I believe in 1825), it was stated in many of the public journals, that after that *scientific engineer, Mr. Brunel,* had proposed his plans, he engaged to complete the said tunnel, if his *patent shield* was used, for the sum, I think, of 170,000*l.*; and that *three* of the *most eminent engineers* of the day had examined the plans and estimates, and were satisfied of the correctness of all that Mr. Brunel had advanced. Now, what I want to know is, whether the Mr. Philip Taylor, who was one of the said "most eminent engineers," is the same Philip Taylor who figures so *peculiarly*, both as plaintiff and defendant, in the celebrated case of Small *v.* Attwood? If so, it is another proof of the means used to foist this absurd scheme upon the ever too credulous and generous public.

I cannot dismiss this subject without stating how much I admire the consistent and honourable conduct of the Duke of Wellington, who, although a Proprietor, and besieged five different times, never would consent to use the public money for any such purpose.

I am, Sir,
Your obedient servant,
FANQUI.

THE STOCKTON AND DARLINGTON RAILWAY.

Sir,—At a time when the public mind is so much alive to the consideration of the effects likely to result to this country, both in a commercial and social point of view, from the general use of railroad communication, it may perhaps prove interesting to some of your readers to be put in possession of the following table, showing the number of passengers conveyed by the Stockton and Darlington Railway Company since September, 1833, through a district which, previous to the formation of the railway, could not support a three-horse coach running three days per week.

I remain, Sir, yours, &c.,
D. P. H.

July, 1835.

Table of Traffic.

	1833	1834
October	7,422	9,913
November	5,263	9,199
December	4,806	8,561
	17,491	27,693
	1834	1835
January	5,301	8,538
February	5,094	8,053
March	7,053	9,236
April	7,636	12,615
May	9,584	12,050
June	8,426	13,359
	43,064	63,851
1835		
July	9 509	
August	10,236	
September	10,030	

HYDRODYNAMIC RAILWAY.*

(From the *Richmond (Virginia) Compiler.*)

It has long been with me a matter of doubt, whether the water used in the lockage of canals was not in many cases an injudicious application of a valuable power, as in the case of a canal located along the valley of a great river having considerable fall in its bed, like that of the river James, which has 1,222 feet fall from Covington to tide-water, or about 4.74 feet per mile, rendering at least one lock necessary for every two miles in the average.

On investigating the subject, I find that the water-power of the river is of itself equal to the transportation of a greater quantity of tonnage than can be passed through the largest canal, and this, too, with the astonishing rapidity peculiar to railroads.

I will, therefore, lay before you, in as succinct a manner as possible, this new, though simple, deduction of science.

* Something very similar to this was proposed several years ago, by a Mr. Scott, to the Highland Society of Scotland; and it struck us at the time as being so exceedingly feasible, that we have sometimes wondered it did not attract more attention. An account of Mr. Scott's plan was published, we think, in the Society's Transactions, but we cannot at present conveniently refer to the work.—ED. M. M.

The locks of the Chesapeake and Ohio Canal are 100 feet long, 15 wide, and, say we take one of the most approved lift, 8 feet; the "prism of lift" will then contain 12,000 cubic feet of water, which will weigh 750,000 lbs. Every time the lock is emptied, this quantity is transferred from a superior to an inferior level. If the valves are opened simultaneously, I am informed that the lock can be filled and emptied in little more than two minutes; but say that it takes three. Now, this water is power, and if it were applied to a properly constructed "breast-wheel," or where the fall of water is greater, to a "pitchback," we should have 4-5ths of it available to set any machinery we think proper in motion. Let it be applied to an endless chain or rope, passing over suitable rollers along the line of a railway, after the manner of the stationary system of steam-engines, we shall have a water-power railway, entirely free from the objections that can fairly be urged to the stationary steam-engines, of the necessity of keeping up the fire and steam, &c.

When the stations are 2½ miles apart, 1-20th of the power, according to Tredgold, will be expended in moving the chains; but I will allow a 10th of the power to effect this object on 2 mile stations, the chain being worked but for 1 mile.

We have, then, the 4-5ths of 750,000 lbs. (the 1-5th being lost in the application to the water-wheels) equal 600,000 lbs., which, falling 8 feet in 3 minutes, is equal to 1,818 lbs. moved half a mile in the same time; which is at the rate of 10 miles an hour. Deducting from this the 1-10th, as that part lost in moving the chain, leaves 1,637 lbs. And as 10 lbs. are equal to the transportation of a ton, with the commonest railway-waggons, it follows that the above power is equal to the transportation of 163.7 tons over half a mile of the road, while a boat would be passing through the lock of the canal; or it will transport 81.8 tons over a mile of the road in the same time, which is at the rate of 20 miles an hour!

But the maximum rate of transportation on canals is 2½ miles an hour; and as the mass moved is inversely to the velocity, we shall at this rate be able to transport 654 tons.

The water used would be at the rate of 66.6 feet per second. James river, even at Covington, in a dry season, yielded nearly three times this quantity, as appears from the Report of Mr. Crozet, who measured Jackson's river and Dunlop's creek in August and September, 1826. The mean of the results obtained by this engineer is 177.6 cubic feet per second, or 10,656 feet per minute; and we have this quantity with 7.11 feet fall per mile, the average down to Pattonsburg; before reaching which, however, the volume of water is more than doubled; and as we descend the river, although we have less fall per mile, we have at least six times the quantity of water to compensate for it; and the fall is still about 3½ feet per mile.

The heavier trade being descending, will add to the effect of this power; but disregarding this favourable circumstance, omitting the decimals in the fall per mile, and taking the minimum quantity, we have 10,656 cubic feet of water, equal in weight to 666,000 lbs., which, if permitted, will of course fall the 7 feet in a minute, and is, therefore, equal to 4,662,000 lbs. falling 1 foot. Deducting 1-5th for loss in application, leaves 3,729,600 lbs. Now, the load we can transport will depend on the velocity at which we would travel—say that it shall be 10 miles an hour, which is 880 feet per minute.

Dividing 3,729,600 by 880, the quotient is 4,238 lbs., moving with the velocity of 10 miles an hour!

From 4,238 deduct the 1-10th part, for that lost on mile stations, in moving the chain, or rope; and dividing the remainder by 10 for the friction per ton of the carriages, and we have 381.5 tons transported at the rapid rate of 10 miles an hour!

And as each and every mile furnishes its own moving-power, it follows that it is equivalent to keeping this quantity in motion on each mile throughout the line at the same time. And as the distance from Richmond to Covington is 257½ miles, this may amount to the enormous quantity of 98,236 tons; or to the transit and delivery of 3,815 tons hourly!

Having thus demonstrated the amplitude of this moving-power, to an extent probably far beyond any demand we shall be able to make on it—which will be better understood by the general reader from the fact, that but 17 hours would be equal to the transportation of a greater quantity of tonnage than passed over the whole Baltimore and Ohio Railroad in a year, ending 30th September, 1833—it now remains to show that it can be employed at a reasonable expense.

The expense of erecting works for hydrodynamic transportation will depend on their scale, or magnitude, and on the greater or less permanent character of the materials used in their construction; also, on the extent to which we would employ the motive-power. With regard to the latter, however, it should be observed, that we obtain it so cheaply, and in such excess, as to obviate, to a great extent, the necessity of expensive grading. This adaptation of fixed power to an undulating surface, of any degree of slope,

renders it peculiarly applicable to mountain localities, as by its means we can cross the bends of the river, thus shortening the distance, while a canal, or even an ordinary railroad for locomotives, should be conducted round them.

Another important advantage derived from the employment of this cheap power, is that we can substitute, for the iron rail, a broad granite tramway, similar to that extending from London to the West India Docks; which, although it will cost more per mile in the first instance, yet it will have great permanency to compensate for this. But the most important advantage to be derived from the granite tramway, is, that any man may bring his own farm-waggon, and, leaving his horses behind him, be drawn to market at a rate of 10 or 20 miles an hour, which would be in less time than would be spent in passing the locks of a canal: thus freeing the work entirely from the odious charge of monopoly brought against railroads.

To form an estimate of the cost, it will be necessary to suppose the works adapted to some definite amount of trade. Say that it shall be to the delivery of 100 tons per hour, or to the transportation of 50 tons at a time, at the rate of 10 miles an hour.

For this purpose I will suppose it necessary to erect a dam at every 4 miles; and that they may be built in the most substantial manner of stone masonry, I will estimate them at 10,000 dollars each; the average width of the river up to the Blue Ridge is 699 feet; above the Ridge, it will only be 275 feet. For water-wheels of the best and most durable construction, say 3,000 dollars.

Thus we have 13,000, which, divided by 4 miles, gives 3,250 dollars per mile, as the cost of the moving-power.

Estimate of the Expense.

Motive-power, or proportional cost of dams per mile	D.3,250
Ropes, a double line per mile	1,800
Rope-rollers, put up	850
*A broad granite, or marble tramway, double track	8,000
Grading and bridging per mile, say	2,000
	D.15,900
Add 10 per cwt. for superintendence	1,590
	D.17,490

High and unfavourable as the above estimate is, yet the whole cost of the moving-power, including dams, water-wheels, ropes, and rollers, will be much less per mile than such locks as those of the Chesapeake and Ohio Canal, which cost, as I am credibly informed, 1,500 dollars the foot-lift.

I have estimated for ropes, as they are in more general use than chains; and the above will be the cost of the newly-invented rope, saturated with India-rubber, expressly for this purpose; which is said to increase its strength as well as its durability.

When the stations or water-wheels are placed 4 miles apart, each wheel would have to work 2 miles of the road at a time; but did the trade require it, double, or probably treble the foregoing tonnage could be delivered by erecting an additional water-wheel at each station.

The following is the estimate of the amount of power to work the 4-mile stations, which those conversant with the subject will perceive to be very ample:—

Friction and resistance of 2 miles of rope	600 lbs.
Ordinary friction of 50 tons of carriages and goods, 10 lbs.	500 do.
Allowance for occasional gravity, at 20 lbs. per ton	1,000 do.
Power allowed at the rate of 10 miles an hour	2,100

2,100 lbs. moved 880 feet in a minute, is epual to 1,848,000 lbs. moved 1 foot; which is equal to 154,000 lbs. falling 12 feet in the same time, which is, also, equal in weight to 2,464 cubic feet of water. To which add 1-4th, for loss in application, and we have 3,080 feet per minute, or rather more than 51 feet per second.

For the sake of conveying an idea of the probable cost on a large scale, I have supposed isolated dams to be used at regular distances, but the engineer will, of course, adapt his works to suit particular localities, sometimes preferring a continuous canal, substituting water-wheels in place of locks, and thus discharging the water, as it is used, into the next consecutive reach below. Or where great length of level occurs, the wheels may be made to discharge their water into the river, to be again taken out of the next dam.

On canals already constructed, where they have considerable lockage, and plenty of water, it is obvious that the trackage may be effected by the foregoing means; that is, by erecting a water-wheel alongside of a lock, and extending a chain down the margin of the canal on the one side, which would be returned up the other.

And as they no longer need the tow-path,

* Wood and iron rail tracks, like those on the Petersburg Railroad, could be laid in a double track for 6,000 dollars a mile. They would last much longer than when locomotives are used.

they may lay a light rail-track, on which passenger-cars may be drawn by the same power at any required velocity.

But in many cases, where they have not a superfluity of water, they had better substitute water-wheels for their lock-gates, widen their tow-path, and lay down a railway.

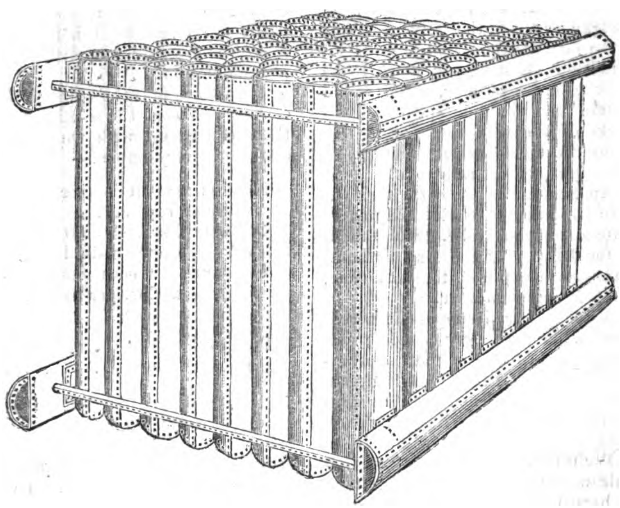
In conclusion, I invite investigation by men of science, as it is certainly a subject of great importance to the country, now so extensively engaged in works of internal improvement.

JAS. HERRON, Civil Engineer.

Richmond, Va., May 26, 1835.

MR. OGLE'S STEAM-BOILER.

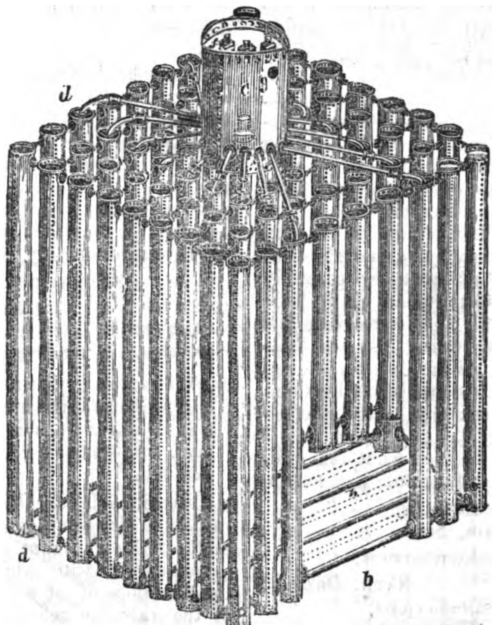
Fig. 1.



Sir,—Although one of your correspondents, Colonel Macerone, has used my name in his communications to you in a manner not justifiable, I have forborne to notice it until I thought the proper time had arrived. I felt certain that your sense of justice and your urbanity would always induce you to insert any communication I might make. It is no longer a question whether locomotion by steam is applicable to common roads. A Committee of the House of Commons, the public, and, lastly, the coach-proprietors, have acknowledged the fact; and very shortly a change in the method of transit on common roads will commence. It is not my practice to write puffs and pamphlets relative to my own performances, and to abuse in contemptuous language the efforts of others who have entered the same arena: I prefer stating a few simple facts, and leaving the public to form their own judgment.

Colonel Macerone lays claim to the boiler, fig. 2, in the accompanying drawings, and took out a patent for it, I believe, in 1833. On seeing that boiler, and knowing that Colonel Macerone and Mr. Squire constructed a boiler similar to my patent soon after my return from Liverpool in 1832, I unhesitatingly pronounced Colonel Macerone's boiler to have been borrowed from mine. In the summer of 1832, I had constructed for a particular experiment the boiler represented in fig. 1; and have since used it in a carriage, and intend to do so again. Any person gifted with the power of vision will perceive that the only difference between them is a circular vessel, and a number of little pipes leading into it (both unmechanical, and neither of any use).

Fig. 2.



Will Colonel Macerone or any other man presume, after the above statement of facts, which nearly 100 men belonging to the factory can testify, to assert, that Colonel Macerone's boiler and mine are not exactly the same? What, then, becomes of Colonel Macerone's patent? What of his bombast and puffing? If Colonel Macerone had not borrowed my boiler, he would not, in all probability, have been further advanced than when I brought my carriage from Liverpool, and thus gave him an opportunity of making a double-tube boiler, which he did not then know how to use. Colonel Macerone is now strutting, a mere jackdaw in stolen plumes. The high-sounding announcement of welding and lapping his tubes is another feather which he has plumed himself with. John Kingate, one of the blacksmiths at the factory at Milbrook in 1832, lapped and welded not only 4-inch tubes, but even tubes of 1 inch diameter and 14 guage. This Bombastes Furioso, who threatens to send John Doe and Richard Roe to inquire if I have pirated his boiler, *produced two years after mine*, is really *vox et præterea nihil*. This claimant to perfection in steam-locomotion is now shown to be performing the jackdaw in the fable. Sometimes he changes his note and whines most piteously, as if no one but himself had suffered from pursuing the same undertaking with inadequate means. That excellent and ingenious man, Walter Hancock, has perhaps fought through much more than the Colonel. Gurney, notwithstanding all the Colonel says, deserved a better fate. Even I would not go through again all that perseverance in the undertaking has entailed on me, for *any earthly reward*. Few, if any, in this country have either been supported or rewarded who were occupied in what may be justly termed great and national works, until support was impertinence, thinly veiled by self-interest, and reward the offer of a per centage or a niggardly pension.

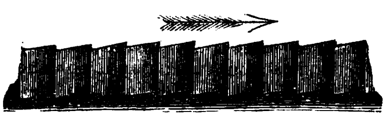
The history of every useful projector, from Hugh Middleton to Watt and Gas-light Windsor proves the truth of the assertion. Steam-locomotion on the common roads will receive no sterling support until the fact of its superiority and safety over animal power and railway travelling is forced upon the public. Amid all the difficulties which have surrounded the persons occupied in bringing steam-carriages to perfection, it is gratifying to know that our countrymen have mutually upheld each other. It has been left to a Neapolitan exile* to try and obtain public sympathy by the abuse of those on the same arena, by carefully collecting the histories of their little failures in detail, and concealing his own, and then narrating his own feats in juxta-position. When all this is done, *à la* jackdaw, it becomes ridiculous and disgusting, and scarcely merits the severity of silence.

It will shortly be seen what real pretensions Colonel Macerone has to the superiority he claims.

I am, Sir,
Your obedient servant,
NATH. OGLE.

58, Baker-street, Portman-square,
July 28, 1835.

IMPROVED STREET-PAVING.



Sir,—I have before alluded to several of the methods which have been resorted to, with a view to obviate the difficulties which horses experience in ascending the smoothly-paved streets of the metropolis.

I have now to notice a very excellent mode of paving which has been recently introduced at King-street, Snow-hill. In this instance, the stones have not been laid level with the surface of the roadway, as was previously done, but have been canted up a little, so as to offer a continuous series of ridges on the upper side, as shown in the accompanying diagram.

This mode of paving affords a firm and secure abutment for the horses' feet, both in ascending and descending, and is well worthy of adoption in all places where the roadway deviates from the horizontal line.

In this kind of paving the sharp edges of the stones are not so congenial to the carriage-wheels as to the horses' feet; but this is of little moment in comparison with the effectual remedy thus afforded against the recurrence of those lamentable accidents, of which, especially in winter-time, the paved hills of the metropolis are so frequently the scenes.

Yours respectfully,
WM. BADDELEY.

July 28, 1835.

PRESERVATION OF TIMBER—FRENCH METHOD OF DRILLING HOLES IN GLASS—DAVY'S SAFETY LAMP—THAMES TUNNEL JOB—STEAM-COACH INVENTORS, &c. &c.

Dear Sir,—I have long perused your valuable Magazine with pleasure and profit, both on account of the liberal and rational views with which you advocate the happiness of the working classes, and of the valuable scientific papers which it contains. The following hints, perhaps, may be useful to some of your readers.

Preservation of Timber.—That great improver of his landed property, Stuart Monteith, of Closeburn, Dumfriesshire, has long practised steeping his Scotch fir (cut into sizes according to the use it is to be put to) in a pond of lime-water, and he finds that the wood so treated lasts as long as Norway fir in roofing. It is notorious that Scotch fir, unless grown in very favourable situations, and allowed to attain a considerable age, is a timber which decays very rapidly when used in roofs or exposed situations. I think with Murray and others, that the corrosive sublimate plan would be too expensive, and, in all probability, very deleterious to the health of seamen and others, as well as those employed in the preparation of the timber.

Drilling Holes in Glass.—I do not see mentioned in your Magazine the method introduced from Paris of boring glass with a drill dipped in spirits of turpentine. A bow and steel drill kept moist

* This is a mistake; Colonel Macerone, though of Italian descent, is a native of England.—ED. M. M.

with the spirit, rapidly drills a smooth hole through glass of any thickness; I have drilled a hole through the thick bottom of a tumbler with a broken triangular file in a very short time. The drill is not blunted more than it would be by piercing iron of the same thickness as the glass.

Davy's Safety Lamp, I think, has been lately cried down more than it deserves: it is well known that if the gauze cover is not padlocked down, the miners frequently remove it to light their pipes; and when we consider that man constantly exposed to danger, becomes reckless of it, and treats it with contempt, arising from thoughtlessness as well as from being habituated to it, there is nothing surprising in the many accidents that happen.

The Thames Tunnel may be completed, but with an expenditure of money much beyond any calculation made public by Brunel and Co. The smuggling method (as mentioned in your Magazine) employed to get the Bill for the loan passed (like the Bill for the Glasgow Lottery), is certainly very contemptible. At the same time, it is a compliment to the two Houses, as it evidently shows that the schemers were aware, if the case was brought publicly forward, that good sense and conscientiousness reigned among the majority, and that they would never grant a loan of 247,000*l.* of public money for a work unlikely to succeed. Isaac Milburn, an ingenious millwright, proposed the following plan for rendering the ground water-tight over the part in which the men were commencing to work:—After claying the part at the bottom of the river, lay over it sheet lead; the weight would keep it down, and the sheets could be cast of any size; the metal would sell for its full value after being used.

The Steam-Coach Inventors.—Gurney, Dance, Ogle, Macerone, Russell, &c., have all talked much of their success, and of the wonders they had performed, or were to perform. But as yet, what have they really done? Hancock has boasted none, and has done a great deal; the slow motion which he has applied to his steam-coaches is a great improvement, which any practical mechanic will at once see.

Agricultural Distress.—The representatives of the landed interest in our legislative assembly, who are constantly bringing forward abortive plans for relieving the distresses of the agriculturist, contrive to keep the only means out of sight, and that is, lowering the rents. Good landlords, who really act up to the maxim of live and let live, are scarce: rents inadequate to the times have ruined and are ruining the working farmer.

Yours truly,

ARTHUR TREVELYAN.

Wallington, Newcastle-upon-Tyne,
June 9, 1835.

THE PATENT LAWS.

Sir,—It seems the Patent Laws are again under discussion, and certainly not too soon. If I have rightly understood the principle on which they have hitherto been founded, it is this; that to encourage invention, for the sake of the public benefit, the privilege of exclusive use is granted, *as a bounty*, to the inventor. From the adoption of this principle flows, as I conceive, many of the absurdities of these laws: it does not express the justice of the case; neither is it the common sense view of the subject; consequently, as legal theory or evident justice happen to prevail, contradictory provisions are made, and obscurity and uncertainty take the place of the clearness and precision which ought to characterise the rule every man is required to walk by. Let us try whether a just and simpler principle will not afford clearer traces of the needful regulations.

The right of ownership is founded, primarily, on the expenditure of effort producing or procuring the thing to be owned; secondarily, on the voluntary transfer of the things so produced or procured. It is the office of law to protect this right of ownership.*

Invention is an effort which confers right of ownership, and therefore of exclusive use: so far then *every* invention

* Political society is, or ought to be, neither more nor less than a confederation for the protection of ownership: but as each section of the community has had favourite objects to accomplish, the powers, entrusted by the whole to the guardians of ownership, have been unduly used to accomplish these favourite objects of the sections. Hence the mischievous complication of laws. Rightful safety, not happiness, is the true object of political government: when safety is secured, happiness will always be sought by individuals and spontaneous associations in ways which if not the best possible, are always tending to perfection, and are always better than any which can be devised or executed by authority.

has, *of right*, claims to the protection of law.

But, 1st. The protection of law can be *practically* administered only to ascertainable rights, and, therefore, in the case of property arising from invention, only to those which are described and registered. Hence only the necessity of a document like a patent at all,—the *right* is complete without it, except only that it is not publicly ascertainable.

2d. The protection of law can be *justly* conferred only on claims which interfere not with the rights of others: but every person has a right to use the knowledge which has become common, and every person, too, who has previously or independently invented the thing for which a patent is asked, or to whom he has voluntarily communicated his invention, has right to use it. To prevent, then, the legal establishment of an interfering, and therefore invalid right, *publication* is necessary.

3d. It is of the nature of all knowledge to become in time common. Hence the necessity of limiting the duration of the legal right; which limitation does no injustice, since it conforms to the nature of the case as it would equitably exist without law: which nature of the case is well known to every man who expends his labour on the acquisition of rights of this description.

From the first of these positions it follows that all expense, more than is absolutely necessary for the describing and registering the invention, is not only a measure of impolicy, but a violation of right:—1st. To those who, notwithstanding the expense, obtain the protection of the law;—2dly, and principally, to the multitudes, who, by that expense, are prevented from establishing their rights.

To carry the second into effect, widely-extended publication is necessary previous to the legal establishment of the right: if it be found needful to make that publication in some authoritative form, it should be done partly at the expense of the public, since it is in accomplishment of a legitimate object of government, and partly at the expense of the individual, since it is for his particular advantage. The most extensive and elaborate publication might certainly be effected for much less money than is now spent in extravagant fees and useless forms.

The revealing of the invention *without declaring the intention to maintain the right*, is certainly an invalidation of the right: for the knowledge of the invention is thus voluntarily given away, and no law can interfere. But the publishing or revealing the invention, *accompanied with a declaration of the right and of the intention of maintaining it*, promotes the object of the law, and ought to be protected and encouraged.

On the above principles, if the right to a patent remain entire, it is a proper object of sale or other voluntary transference.

To determine the proper duration of a patent is difficult. Inventions involving the discovery of natural principles, or accomplishing purposes not before accomplished, seem in justice to require the longest term;—those consisting of new applications of known natural principles, or accomplishing old purposes by improved methods, appear to be the next class:—the shortest period may be allotted to new arrangements, new patterns, &c. &c. Whether a classification of this or of any other kind would be practicable, and if so, whether it would facilitate the solution of the question, must be left for future inquiry.

You will perceive, sir, that my object has been to furnish merely such a sketch of the application of the principles I set out with to the subject of patents, as may serve those of your readers who are interested, for materials for further thought. I perceive that both in text and note I have expressed myself too dogmatically: I trust this has arisen merely from a wish to avoid interrupting the argument by expressions of qualification or deference. If it be the *first* duty of a public writer to seek the truth diligently and expound it carefully himself, it is not less imperatively his *second* to remember that others who differ from him may know as much, and love the truth as well as he—I hope to forget neither.

I am, Sir,
Very respectfully yours,
J. CHAPMAN.

July 27, 1835.

VIS INERTIÆ—IS WHAT?

Sir,—Your correspondent, X. Y. Z., in his article headed, "The Undulating Railway System—the True Question,"

asks whether "locomotive power has any other power to overcome than that of friction when a heavy body is in motion?" He answers his own question by saying, "I believe, myself, it has the *vis inertiæ* constantly to oppose, although apparently the body may be in a state of uniform motion," &c.

X. Y. Z. (a profound algebraist, I ween) no doubt imagines that he has made a very important discovery in the application of this force, 'yclept *vis inertiæ*, or the *force of inactivity*; but, to the best of my belief, he has only found out a "mare's-nest." Before offering any other opinion of my own on this subject, however, I beg leave to give a few quotations from the writings of a gentleman, whose extensive knowledge in every branch of mathematical and physical science is well known, namely, the late Professor Robinson, of the University of Edinburgh. In speaking of *inertia*, vol. i. p. 96, of his "Mechanical Philosophy," he says:—

"The word *inertia*, which had been employed by Kepler and Newton to express the indifference of matter as to motion or rest, or its tendency to retain its present state, has got other notions (farcical ones they are, too) annexed to it by subsequent writers, *and has been called a force—vis inertiæ*."

Mr. Rutherfurth, in his "Lectures on Natural Philosophy," which were read in the University of Cambridge with great applause (this was before the march of intellect had taken proper root), is at great pains to show that matter is not merely indifferent, *but resists every change of motion by exerting what he calls the force of inactivity!* (something exactly of the same nature to the force that a dead horse exerts), by which it preserves its condition unchanged. "But surely," continues Professor Robinson, "this is as incongruous as to speak of a square circle," &c. No doubt this over-wise Cambridge Professor wished to attach a degree of importance to *inertia* which neither Kepler nor Newton ever dreamed of. Your correspondents, Kinclaven and Mr. Mackinnon, seem to think that the word *inertia*, as far as regards its meaning in physical science, might, without any great injury, be placed in schedule A. It is certainly much to be regretted that so many writers on applicate science should have obscured the subject by the infusion of so much scholastic and metaphysical gibberish. Professor Robinson adds:—

"The terms are the worse by having some meaning, for this has frequently misled us into false notions of the manner of acting."

"These doubts and difficulties in the study have all arisen from the introduction of the *notion of resistance, or force exerted by matter in order to remain as it is*."

"It would have been infinitely better to have employed the term *re-action*, for this is the expression of the very fact," &c.

But although we were to allow the existence of this droll *force of inactivity*, or *inaction*, in unanimated matter, what then? Cannot all the opposing forces to locomotion be measured in terms of weight, or in terms of gravity? How this is to be done has been shown, over and over again, by your scientific correspondents, Kinclaven, Mr. Whitehead, Mr. Herapath, &c. So that if there actually should exist such a force as that of inactivity, its effect is included in the general term (not forgetting the resistance of the air), namely, the function of all the moving parts; and all this must be determined by actual experiment.

X. Y. Z. also asks the question, "Are not the opposing forces equal when a train of carriages is moving at the rate of 30 miles per hour," &c. This question, although it does not display much of the *force* of perfect wisdom, is particularly addressed to your able correspondent, Mentor; I shall, therefore, say nothing in answer to it.

In conclusion, Mr. Editor, although I have no faith in the force, *vis inertiæ*, as it regards inanimate matter, I have no objection to allow its full *force* with respect to animated matter, and more particularly so in such hot weather as we have lately experienced; for my own part I am willing to confess, that I have been so completely under the influence of the force of inactivity for this month past, that though sorely provoked to animadvert on some things which have lately appeared in your journal from the pen of Mr. Herapath, on the subject of railways, I have not yet been able to muster energy enough for the task. By-and-bye, however. Meanwhile,

I am, Sir, yours, &c.

IVER MACIVER.

P. S.—I beg leave to thank Kinclaven for the correction he justly made in my last article. The only recompense I pro-

mise him is, that if he should ever fall into a like mistake, I shall endeavour to set him right.—I. M.

THE CLAIMS OF INVENTORS TO PUBLIC PROTECTION AND ENCOURAGEMENT.

[We are indebted to our esteemed correspondent, Mr. R. W. Dickenson, of Ilfracombe, for enabling us to rescue from the oblivious obscurity of an old American newspaper the following admirable observations on the encouragement of inventive genius. How striking is the contrast between the profound and enlightened views here developed, and the narrow and superficial plans of patent law reform which have been recently brought forward in this country! And how shrewd and far-sighted the writer's anticipations of the new discoveries and inventions which would in later times astonish the world! Well may Mr. Dickenson say of him, that he must have been "a man before his day." Even at the present day—nearly half a century later—the number of those prepared to embrace his views is, we fear, lamentably small.—Ed. M. M.]

A SUGGESTION.

(From the *National Gazette*, published at Philadelphia, of Dec. 15, 1792.)

It was an ancient proverb, "that he that invented means whereby he could cause two spears of grass or corn to grow where but one would hitherto grow, deserved more from his country than all the heroes and politicians of the age." Why? Because it is on the produce of the earth that we subsist. Should not America adopt the following proverb, viz. He that invents improvements on any art, whereby one man can do as much as two men could hitherto do, deserves more honour and favour from his country than any two heroes or politicians. Why? Because it is to the arts that we are indebted for all the conveniences and luxuries of life, even most of the useful productions of the earth. Deprive us of the arts, and we immediately relapse into a savage state. To the arts we are indebted, for our fine farms and plentiful harvests—fine ships and extensive commerce—fine apparel and easy carriages—fine, convenient, and comfortable houses, and great and populous cities. Should not a wise nation nurse and cultivate them by granting them all possible aid and encouragement, seeing that without them nine-tenths of us would inevitably perish for want of the necessaries of life, and the remainder be in a worse situation than the untutored savage of the woods? As the precious metals and stones are hid in the bowels of the earth, and are with much difficulty, labour, and expense, brought forth and polished and refined for use—so hath nature hid the useful arts, that it is only him that searcheth and diggeth with diligence and unwearied perseverance, that shall find them. Therefore, who is more worthy of being honoured and esteemed by his country, than he who searcheth out their secret hiding places in nature, and bringeth them forth to the aid and assistance of man. To whom are we indebted for this great service? To the great and noble of the earth? No! Those things are mostly revealed to the humble, diffident, and modest; and they have mostly been of but low circumstances that have ever invented any thing useful, because they are men who prefer knowledge to riches—and hence their greatest difficulty is, after they have invented an improvement to bring it forth into practice. Therefore, it is the interest of a nation not only to secure to the inventor (for a limited term) the exclusive right to his invention after he has brought it into use, *but to assist him in bringing it into practice, if he cannot do it himself;* because what is it to a nation if a mine of gold be discovered, if it never be opened? The discoverer declareth that he hath found a mine of gold—but no one will believe him, so far as to assist him to open it, till they see and feel the pure metal. If he goes to work alone, and neglects to provide food and raiment for his family, will they not starve with hunger and cold before he can attain his end, by the tedious and expensive process: when he findeth want pinching him, he is forced to give out his pursuit, and is laughed at, and all men agree there is no mine there, and no one will attempt it again for a century. How often hath this been the case? I am of opinion that no nation hath yet hit on the most effectual means of promoting the progress of the useful arts. They have said to the inventor—*Produce us the pure gold from the mine, and we will secure you the right of getting all you can for fourteen years.* Whereas, they should have said—*Show us the place where the gold is, and convince us by good reasons that it is probably there, and we will all come and help you a day to dig it out, and you shall then have all you can get for fourteen years; you must, however, pay us for our labour. But if you and we should alike be mistaken, it will be no great loss to us—pay us when you can.* If our Congress should adopt a patent system on such principles, I dare venture to say, that the useful arts in this country would flourish with a growth unknown in the history of nations. And as wealth and power is the offspring of art, we should in time be able to dictate to

the world. Suppose, for instance, that a sum only equal to one-fourth part of the savings by one improvement, that is already brought forward (the inventor having luckily been able to reduce it to practice), viz. Mr. Oliver Evans's improvement on the art of manufacturing wheat into flour. I have read a pamphlet written on the justice, policy, and utility of establishing an effectual patent system for promoting useful arts; and although I do not agree with the author exactly, I find he hath made it appear that Mr. Evans's improvement may in time save the labour of 4,000 men in this country, which, calculated at 200 dollars each, is 800,000 dollars per annum; but to speak altogether within bounds, he says it will save the labour of 1,000 men, which, at 100 dollars each, makes 100,000 dollars per annum; one-fourth part of which would be sufficient for a loan to be established for promoting useful arts. I conceive the whole Continent of America cannot produce 25 real inventive geniuses, or as many as could come forward with 25 inventions annually, sufficiently probable of utility and success to merit the assistance of a loan; and I conceive that 1,000 dollars would be sufficient for experiments on most inventions; and as all that were successful could pay back the money, and, perhaps, many of those that were unsuccessful; therefore it might be expected that such an institution would be but a very small expense to the public, and of great utility.

I cannot refrain from hoping that some such measure will be adopted, because I know of several useful discoveries that now lay dormant for want of such assistance, and are in danger of being buried with the inventors. *But if the assistance be granted, I shall hope to live to see the day, when our harvests will be reaped and thrashed by machines; our rooms in cities warmed with half the present expense of fuel; and the power of elastic steam applied to move saws and planing machines, whereby much of the laborious parts of the work of carpenters in building houses will be done by that power, and, perhaps, even applied to the propelling of land-carriages with heavy burthens.* I know persons that propose *all* these inventions (and not without great probability of success), as that great power of steam may be applied to many things to which it has not yet been applied.

Why would we expect an inventor to make improvements at an expense, perhaps, equal to all he is worth, when he is to enjoy it only fourteen years? What tenant will improve a farm at his own expense, when he is only to possess it that time? If the public is to be the proprietor at the end of the aforesaid patent term, why not pay the expense of the experiments? The very hopes or expectation of a Patent will cause the inventor to keep his discovery a profound secret (if he is not able at present to reduce it to practice, and take out a Patent), until he or his children shall be able to reduce it to practice and pay the Patent fees: and herein appears the ill effects of that ungenerous policy of taxing genius by taking large Patent fees. I believe a great majority of the people are in favour of Patents, especially amongst the ruling part, as hath appeared in several instances; it is only a few ungenerous, and, consequently, unpopular characters that are opposed thereto. But it appears that congress hath hitherto considered the Patent Law as an unimportant object, not worthy the attention that other more important objects demand. When we consider, however, that the wealth, power, and happiness of a nation is always in proportion to the perfection of the arts in that nation, and that the perfection of the arts is always in proportion to the encouragement they meet with, surely it is evident that there never was, nor can appear a more important object before Congress.

ARTIST.

Philadelphia, December, 1792.

NOTES AND NOTICES.

The Sheffield and Rotherham Railway.—A Committee of the House of Commons, after a patient and protracted investigation, came to a vote on the merits of this Bill, and decided by a large majority that it would be beneficial. The opposition of the Duke of Norfolk, however, has been successful in defeating it in the House of Lords. When the Lords' Committee was about to divide, the friends of the Bill were quite sanguine as to its success. There were ten Peers present, and it was expected that the number for and against it would be equal, and that Lord Harewood, the Chairman, would give his casting vote in its favour. Unfortunately, however, just before the division, two other Peers opposed to the Bill entered the Committee-room, and the preamble of the Bill was negatived, the numbers being seven against and five for.—*The Sheffield Independent.*

Extraordinary Upheaving of Masses of Rock.—A few days ago a remarkable phenomenon occurred at the quarry of Dr. Hughes, in Toxteth-park. Whilst the workmen were engaged in their labours, they observed a mass of rock with a quantity of superincumbent earth upon it, which would weigh at least 100 tons, suddenly to heave and rise six inches; after which it immediately settled into its proper position, cracking the rock in various places, and leaving other marks of the convulsion.—*Liverpool Mercury.* The preceding statement will probably appear incredible to many of our readers; but it is an undoubted fact, that a few years ago an immense mass of rock in the tunnel of the Leeds and Liverpool Canal rose several inches and stopped the navigation of the canal until it was cut down to the former level.—*Manchester Guardian.*

The Gurney Job.—(From the *Glasgow Chronicle.*)—We trust that such a job as this will not be entertained by a reformed House of Commons. Mr. Gurney, our readers will recollect, brought down one of his carriages to Glasgow, but instead

of running it from London through some of the great English towns, which he should have done had the invention been practicable, he brought it in a smack to Leith; and when he tried to bring it by the common road from Edinburgh to Glasgow, he required the use of horses to drag it up several parts of the road which could not be called very steep. When he did reach Glasgow by such aid, he exhibited his carriage in the Barrack-square, which was about the same in respect of showing what it could do on a common road, as if he had run it on his dining-room floor. Besides, when he was asked to run it on the walks in the Green, which were nearly as smooth as a bowling-green, he declined to do so, on the pretext that it might excite a riot; although he was assured by Captain Grahame, then the Superintendent of Police, that no such fears needed to be entertained.

Steam Conveyance to the Lakes.—A new steam-vessel called the Windermere, belonging to James Winder, Esq., of Liverpool, with a new pair of engines, upon Mr. Hall's patent principles, made by Messrs. Fawcett and Preston, has commenced running daily between Liverpool and Ulverstone. The engines are stated in the Liverpool papers to have worked in the most satisfactory manner. Although intended to make only 28 strokes, they made from 32 to 34 strokes per minute.

The Publisher of the *Mechanics' Magazine* has received a letter from the Solicitor to Messrs. Newton and Berry, of Chancery-lane, in which he states, that the passage in the article on Lord Brougham's Patent Law Amendment Bill, inserted in this journal of the 25th ult., which speaks of individuals "quitting their proper occupations of trunk-making, globe-making, and the like," for "the business of preparing specifications," is "considered" to be directed against his clients, who are, he says, "the only persons in this country who carrying on the business of preparing specifications, have ever been engaged in the occupation of "globe-making." The Publisher now requests that we will express his regret that he should have published any thing admitting of such a construction, and to state that on inquiry he is informed, Messrs. Newton and Berry have for many years carried on the business of agents for soliciting Patents and of preparing Specifications connected therewith, with great credit to themselves and benefit to their employers. The Editor, who is the author of the article complained of, begs to add for himself, that he, too, regrets much that a firm of such good credit and approved ability, as that of Messrs. Newton and Berry is thus certified to be, should have been "considered" by any one as touched by his remarks. He must distinctly disclaim having alluded, in his "globe-making" count, to that or any other existing firm; and but for the obvious danger of being more explicit, he could easily show that it is a great mistake to suppose, that there is nobody else to whom his remarks can apply.

Horse Collars.—Sir, May it not be possible to avoid the present difficulty of fitting a collar to the shoulder of a horse and the serious injury to the animal, consequent upon a bad fit by the adoption of an elastic medium, such as water or compressed air, which, if properly made, will be not only softer as a padding, but will produce the desideratum of an equal pressure upon all parts of the shoulder. Not being at present so situated as to be able to give my attention to the manufacture of one as an experiment, I can only direct this to the eyes of any among your numerous readers, who possess the opportunity as well as inclination of putting this matter to the test, merely requesting, in return for this hint, that he will favour me with the result of his operations. I remain, Sir, your most obedient servant, W. M. P. 46, Lower Belgrave-place, Pimlico.

Railway Locks.—(See Mech. Mag., present vol., p. 202.) I remember remarking in the *Chester Courant*, March, 1827, on the advantages that I conceived would result from the application of a proportionate screw, or lever-lift, to raise and lower carriages on branch railways; and in December, 1830, in the *Liverpool Mercury*, in alluding to the long inclines on the Liverpool and Manchester Railway, I suggested, that whenever there was an incline of several miles, it would be a material relief to have occasional portions of horizontal plane, to enable the engine to recruit its power and speed; and also that, where the summit level could not be gained desirably soon, a lever-lift, acting on a platform, might raise the engine, &c. several feet. It seems to me that the Lock principle, as also Mr. Badnall's Undulating principle, may be followed out to great advantage generally; but, at all events, there can scarcely be a doubt of their being well adapted to branch lines to Townships, &c.—THOMAS LUNT. Chester, July 18, 1835.

We are told that the same legal gentleman whom we had to take to task last week for a very contemptible misrepresentation of one part of our conduct, in regard to the Patent Law Amendment Bill, has been going about telling every body he can get to listen to him, that our opposition to the Bill originates from personal pique towards Lord Brougham. He *knows* well that there is just as little foundation for this as for his former charge against us. To the Bill of 1833, with which Lord Brougham had nothing whatever to do, we were quite as much opposed as to that of 1835, of which his Lordship is the reputed author; and for the same reasons nearly, as any person who may choose to be at the trouble of referring to what we said in 1833, on the subject, can satisfy himself. There are two articles in our present Number on the principles which ought to regulate any reform in the Patent Laws, to which we beg to invite the particular attention of our readers.

"Why not petition against Lord Brougham's Bill?" To this question, which has been put to us by several correspondents, our answer is—it is not worth while. We do not think the Bill will pass this Session; and if it does, it will, by making bad worse, only help to accelerate that thorough reform in the system which is so urgently required.

Can "John Snug" satisfy us in any way of the authenticity of the extract with which his letter concludes?

Communications received from Mr. Bayley—D. S.—M. al Moonghie—Mr. Clark—B. V.—Lieutenant Wall—Mr. Alison—Amicus—An American.

Errata in the description of Dagleish's Prime Rails and Pedestals, No. 620:—

P. 226. Fig. 3 is turned upside down—the base of the pedestal is shown undermost instead of being uppermost.

P. 228, column 2, line 20 from the bottom, for "tight" read "light."

P. 229, column 2, line 23, for "rails" read "nails."

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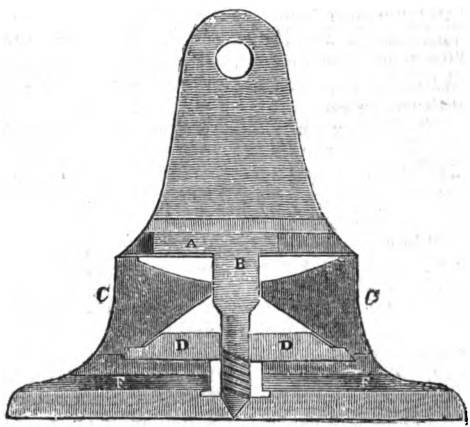
Mechanics' Magazine,

MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 627. SATURDAY, AUGUST 15, 1835. Price 3*d*.

DAKIN'S TURNING-LATHE.

Fig. 3.



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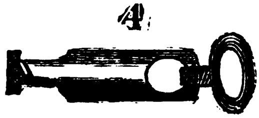

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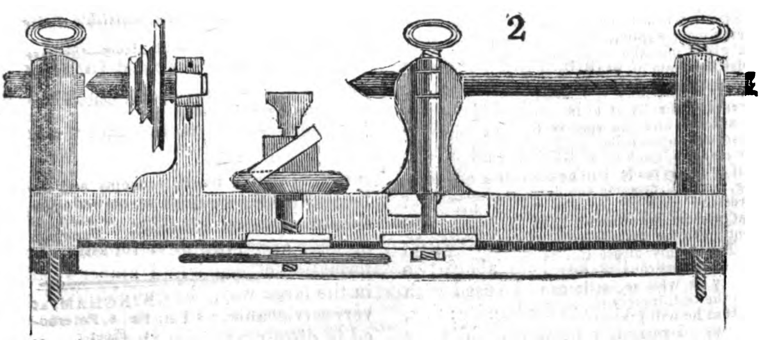


DESCRIPTION OF A SIMPLE AND ECONOMICAL TURNING-LATHE, WITH NOTICE ON TIN CRUCIBLES. BY MR. G. DAKIN, OF DEREHAM, NORFOLK.

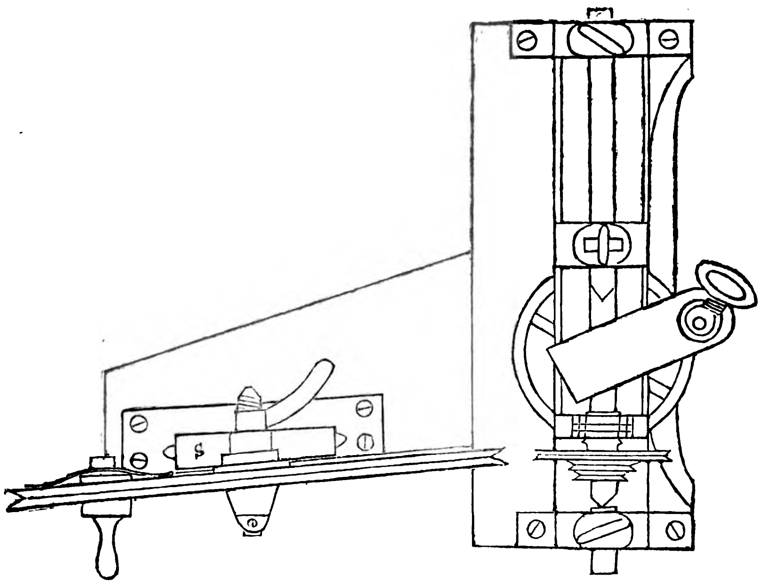
Sir,—I have sent you a plan (fig. 1), elevation (fig. 2), and section (fig. 3), of a turning-lathe, which I have lately finished, and which will possess the following advantages over those of the common construction. It is lower, stronger, simpler, more easily constructed, will work as true, and yet will come cheaper. The stand, two triangular rails, three puppets or jacks, and the open hole for the mandril, were all cast in one piece without a core; and hence the greater cheapness. The moveable puppet, and also its moveable centre (shown separately in fig. 4), are fixed for light work with one turn of a screw. For heavy work an additional screw fixes them almost immoveably both to stand and rails. The rest is fixed for light work by applying one finger and thumb to a horizontal fly-wheel; and for heavy work by a similar application to each side of the wheel. There is thus no time lost in looking for a wrench or a tool to turn the screw with, as the fly-wheel is always ready for use, yet never in the way. The wheel, pulley, collar for the mandril, chucks, &c., were cast of an alloy of zinc and pewter; and when so made, are as cheap as when of cast-iron, and yet work easier than brass. The wheel is inclined a few degrees to the right, and also a few degrees in the same direction from the perpendicular, by which means the centre of gravity is thrown within the base, and the catgut does not rub even against its knot, and will, consequently, last a great deal longer than usual. It is also much more convenient to turn in this way, especially when turning any thing long, for although the board is only 14½ inches long, and the centres 2 inches high, it will turn any thing at the end of the mandril nearly 8 inches diameter, or a cylinder 10 inches long. The support for the wheel is made short, so that the lathe goes nearly to the bottom of the board; and by sliding the hand to about two inches from the axis, it may be used with the foot by tying a line to the handle: this, however, would only be worth while for light wood-work.

In the section (fig. 3), A is the dovetail; B, the rest-bolt; CC, the rail; D, square-piece; FF, fly-wheel. In the plan (fig. 1), SS is a tightening slide.

The collar for the mandril was cast in its proper place with a strong shank and over a bent pin. The fly-wheel was made of iron wire, hard soldered up, but the screw is brass, bedded up with soft solder. The brass screws for the centres were cast in a common fire, in common sheet tin crucibles.

I find that these tin crucibles answer admirably, and should think they must prove a valuable acquisition, both to the laboratory and the workshop, as they will be found to possess the following advantages:—They will come much cheaper; they are not liable to crack; they are made of the refuse of an article of *home* production; they can be made in all places and of any shape; being good conductors of heat and very thin, they bring the substance to be melted in closer contact with the fuel, and will, consequently, act in a shorter time, or with a less degree of heat, than any crucibles made of clay or black-lead; they will also last as long when luted with lime and borax. I have used a pair of cylindrical ones (which are double seamed up, the different sizes fitting close into each other, and forming covered crucibles which may be used without sand,) for making different sorts of charcoal in, for engraving, &c., for which they are well adapted, as it takes a large crucible of the common shape to make but a small cylinder of charcoal. I have used mine above twelve times, an hour each time, and *without any lute,* and they are not worn out yet. When hard soldered up they are very useful substitutes for ladles for melting the fusible metals and resinous substances. They may be also made *perfectly* air-tight, so as to stand the pressure of several atmospheres at a red or even a much higher heat, and might therefore be useful in the investigations now going on at the laboratory of the Geological Society, respecting the formation of artificial minerals, and the effects of heat and pressure on rocks. In the formation of copal and amber varnishes in the large way, they might likewise be very serviceable, as I have lately succeeded in dissolving them, both in spirits of wine and turpentine, by the same means, under a pressure of about twenty atmospheres. The liquid amber when dropped

Fig. 1.



on a piece of glass, flows into a transparent sheet, and would, no doubt, form an elegant varnish for electrical purposes, or for joining pieces together.

The centre is the whole length of the lathe; all its motions are quickly and easily made, yet there was very little filing required, and for rough work it might even be left from the casting, as all its parts stand upon a triangular bearing.

The wheel adjusts itself to the small pulley, by turning its bolt at right angles, so as to hold by a smaller shoulder.

I am, Sir,
Your obedient servant,
G. DAKIN.

Dereham, Norfolk, January 30, 1835.

Extract from a subsequent Letter of Mr. Dakin's, of date the 26th February, 1835.—"I have lately seen the tin crucible tried in the large way for melting (I suppose) about half a hundred weight of brass. It was luted with lime and borax, and the workmen judged from the appearance of it, that crucibles of this kind would last longer and come cheaper than the black-lead ones—I am not sure, however, that lime is the best lute that could be applied. Perhaps three parts of some of the common magnesian limestones or dolomites with one of sand, would answer better. Let me here notice another advantage attending the use of tin crucibles; the bottoms of the black-lead ones have been known to break off in carrying them to the flasks, which is very dangerous to the workmen; but this could scarcely happen with a tin one. I make no doubt they will be found useful for many purposes that I did not at first anticipate, especially in subjecting substances to high heats and the pressure of their own vapour."

RAILROAD BARS.

Sir,—I have not hitherto directed particular attention to railroads, but as I read Mr. Daglish's letter of the 26th of May, an idea occurred to me, which I am induced to offer, through your columns, to the consideration of those con-

nected with great undertakings of that kind. I will put my idea as a question:—Is it not possible to produce a railroad with uniform elasticity, or, at least, so nearly so as to avoid the inconvenient and injurious jar experienced while the wheels of a carriage are passing over the pedestals and joints?

To effect this, I propose that the ends where the different portions of the rails meet should have corresponding notches to admit keys, for the purpose of keeping all fair at top. These keys might be extended to the rails on both sides of the road, to keep them parallel and at a uniform distance. The vertical joints where the ends of rails meet to be open, to allow for expansion; and for the same reason also, the vertical joints at the sides of the keys. Horizontally the keys to be as tight as possible in the rails. The rails are to be kept in their vertical position by the mortices in the chairs, and to be fastened down to them by the keys. Each portion of the rails is not to rest on the bottom of the mortices in the chairs, but upon a transverse bar or bars, whose strength and bearing are to be precisely that which will produce the same degree of elasticity as that of the rails, that is, if the wheels of a waggon were passing immediately over these bars, or the keys in the joints of the rails, there would be no more tendency to jar than if they were rolling on the rails in the middle between any of the supports.

This idea may be applied to a great many, or all the variety of forms for the rails; but I think with Mr. Daglish, that the rails, from their upper to their under surface, ought to be as little as possible. And, indeed, to produce steadiness in motion, the centre of gravity of a train of carriages, and the goods they contain, cannot be kept too low.

I am, Sir,

Your obedient servant,

JOSEPH JOPLING.

31, Somerset-street, July 11, 1835.

THE LONDON AND PARIS AERONAUTICAL SCHEME.

Sir,—As you have thought a description of the attempt now making to reduce balloons to some degree of tractability worthy a place in the Mechanics' Magazine, and as your ingenious correspondent, Mr. Baddeley, has promised to treat at large upon the subject, I have thought that it would be as well for your readers to know previously what our Gallic neighbours have done and said upon the subject; so that knowing what has been hitherto accomplished, any remarks elicited from other correspondents may be original, and have previous experience to support them. To this end, therefore, I have translated, and send you the substance, of an article which appeared in *Le Temps*, and from thence was copied into the *Recueil Industriel*, of last August, the Mechanics' Magazine of France, accompanied with the expression of a firm belief that the desired object would be attained, and that the Eagle would navigate the air before the approach of winter, notwithstanding its failure at the first appointed time. The result of these experiments is well known; the aërial ship has arrived in London, though not by a voyage through the air; and either because the projector and his coadjutors imagine that the currents from London to Paris are more favourable than *vice versa*, or because John Bull's pockets are deeper and better filled than those of Jean Crapaud, or because he is considered more *gull*able (the article in *Le Temps* talks much of the *gull*), the public is now gravely assured, that it is to go back to Paris through the air without fail. Whether Kensington Gardens will be more favourable to the modern disciples of Icarus than the Elysian Fields, remains to be seen:—

"The flight of birds is effected by the fluttering of their outspread wings, and thus they traverse a world above ours, over continents and seas. Man, although he braved the dangers of the ocean in his savage state, has not yet, in this advanced era of civilisation, found means of rivalling the light insect which flies above his head. The bird is a thousand (?) times heavier than the air; the surface of its wings is scarcely double (?) that of the body opposed to the action of the atmosphere, and yet it is able to fly over the highest mountains in whatever course it desires. When the kite hovers over his prey, the movement of his wings is so rapid as to be almost imperceptible; the gull rises in the air, and struggles above the sea, and against the tumultuous winds—he seems not to make any progress, yet he rises and advances; sud-

denly he falls almost upon the surface of the sea, and again ascends, always advancing against the wind; he makes progress by tacking about, and offering to the action of the wind an inclined plane and the resistance of his weight. The journeying swallow is borne on a couch of air to the regions of the north, and, without fatigue, travels more than 40 leagues an hour. Is it then impossible, as our *savans* declare, to imitate the birds of the air? Are we destined never to rise above the tops of our houses?

"Mathematical science has proved that the muscles of the arms are not of sufficient power to agitate wings proportional to the weight of our body; and we grant that a vessel cannot be navigated in the air in the same manner as on water, because there is not a similar point of resistance; it is wholly immersed in one medium, while the ship embraces two; a spherical balloon will always be found to twirl upon its axis.

"From the moment when our *savans* discovered a gas lighter than air, and an envelope compact and light enough to contain it, and thus a means to elevate weights in the atmosphere—there wanted only perseverance to attain the desired end. Nature has given us two models to follow—the flight of birds, and the swimming of fishes; in both these cases the body is altogether plunged in a single element. In our navigation upon the water we have two at our disposal, one only of which supplies motion. We should study the locomotion of fishes rather than that of birds, the water having a density as to the fish proportionately as the air has to a balloon—a body of a weight equal to that of the volume of air which it displaces at a certain height. Taking these things into account, we discover in the fish the *nautique aérienne*.

"From this difference of density between the body and the surrounding medium, we learn why the fins of the fish are so small in comparison with the wings of a bird, and the cause of many other differences in the physical conformation of the denizens of the air and of the water.

"The most remarkable thing in the structure of the fish is the air vessel which communicates with the stomach, and which is believed to receive the gas from that organ, whereby the animal is enabled to increase or diminish its own density, and thus rise or sink in the water.

"Naturalists were unable to distinguish different species, either in birds or fishes, by their wings or fins, so great was the uniformity which was found to pervade nature in that respect, varied only in the case of land-birds and river-fishes. The true inhabitants of the air and of the sea, have their wings and fins the same in all climates, because the elements in which they perform their locomotion are universally the same, whatever be their habits or formation in other respects. Varieties in nurture and temperature produce the differences in the beak and plumage, by which the naturalists distinguish species.

"After two years spent in experimenting, M. de Lennox determined to make public the result of his studies and experience. In the form of his aërial vessel he imitated that of the fish, and in its interior placed a vessel which he could fill with air or empty at pleasure, and thus ascend or descend in the atmosphere. He is able, without the least loss of gas, to keep himself in that current of air which may be most favourable to carry it in its course, thus enabling the aeronaut to study the divers currents of the atmosphere. The vessel has also a governor, to render the same services as the tail of the fish, and several oars; and wheels with wings, which are in place of fins. This aërial ship being intended to rival the *eagle* in its flight, has been called by that name. It is of larger dimensions than any previously made; it will carry 17 persons, with provisions, a number of instruments for observations, two compressing-pumps, and all the apparatus necessary to work the ship. With a favourable wind, the Eagle and equipage will arrive in London in *two* hours; in a superior or inferior current it will return to Paris the same night.

"Meteorological science teaches us, that there are currents entirely opposed to each other at different heights in the atmosphere; and that in the interval between these currents there exists a calm, which is the region of the immoveable clouds, from which the swiftness of others is measured. The Eagle will search for a current in the desired direction, and, for the purpose of manœuvring, will place itself in the calm.

"By the exertions of M. de Lennox, and his coadjutors, we hope that France will have the glory of producing the first aerial navigator, as it already has that of the first man who ascended into the air."

Such is the substance of the French "*notice*" of this grand project. It is far from being satisfactory in its descriptive details. It is particularly faulty in not stating the power intended to be applied to work the fins and wheels. Upon this point, I would beg to refer your readers to a letter of your Indian correspondent, Bergein (vol. xix. p. 200), in which he states the desiderata to be:—"1. To steam-engine of such power and so light of construction, that it will be able to move a pair of wings, large enough to raise not only itself, but one or two men, in the air. 2. The cheapest and most

efficacious manner of decomposing water, and collecting the hydrogen gas in such quantities as may be sufficient for the purposes of fuel." Although this suggestion was mentioned with reference to wings merely attached to a car, it will apply equally to the management of a balloon, if indeed it would be at all advisable to place any kind of combustion in the vicinity of so inflammable a gas as hydrogen. I would recommend M. Lennox to apply to Mr. Pearson, who, if he could do all he describes in No. 623, of your Magazine, would no doubt be able to construct a self-acting machine capable of giving motion to the paddles or fins of the Eagle.

The projectors have, judging from the engraving which accompanies the article in the *Recueil Industriel*, made some alterations, perhaps improvements, in its machinery. In the French plate the fins are attached to the sides of the car in a line, and are, if the drawing is correct, about 6 or 7 feet long; while in the English they are attached to the sides of the balloon, are placed in pairs, one above the other, and are about 40 or 50 feet long—thus departing somewhat from their adopted model, the fish, and applying wings about a size proportioned to those of a goose or ostrich, instead of the fins proportioned to those of a whale or porpoise; four fan or paddle-wheels, which appear in L'Aigle, are not to be found in the Eagle: the Parisian has two governors, or tails, one at each end, while the Londoner has only one. These are the alterations which the aërial ship has undergone since its appearance in the *Champs Elysées*, and I think are, for the most part, decided improvements, bringing the thing a point nearer feasibility than before. The analogy which the fixing a vessel filled with a buoyant gas appears to create between the comparative density of the so supported man in the air and a fish in the water, is a very plausible point in the argument for the possibility of aërial navigation; but it remains to be proved that what appears good in theory is also good in practice. If the result should be favourable, I shall be the first to rejoice; but I fear that it will in the end turn out to be what the writer in *Le Temps* has denominated other balloons, "*un bulle de savon*," which will burst the morning before the appointed time of ascent.

The "European Aëronautic Society" have come down somewhat in their pretensions since their arrival in London. From *Paris* the journey was to have been performed in *two* hours, but from *London* it will occupy *six*. How is this? Have the *savans* discovered that the distance there and the distance back are of different lengths—like the showman's wonderful animal, that was *twelve* feet from the snout to the tail, and *eighteen* from the tail to the snout?"

Why, I would ask in conclusion, does not M. Lennox make a few experimental trips before the grand journey to Paris—such, for instance, as from Kensington Gardens to St. James's Park, or even to Kennington Common, or to Hampstead Heath—just to show the incredulous Londoners that the monster is tractable, or to get the machinery into play, or prevent its rusting in the dock? This has been the case with steam-carriages, steam-boats, and other machines, and why should a navigable balloon be excepted? A man puts his finger in a bath to see that the water is not too hot before he plunges head foremost; and I should think aërial sailors would like to take a little journey as near the ground as possible before they flew over mountains and seas.—Yours, &c.

SCRUTATOR MECHANICUS.

July 20, 1835.

MARINE STEAM-ENGINES.

[We lately extracted from the Appendix to the Report of the Committee of the House of Commons on Steam Navigation to India, the evidence of Mr. Field, of the house of Messrs. Maudsley and Field, for the sake of the mass of valuable information which it contained respecting the proportion which the power of the engines of steam-vessels should bear to the tonnage, the consumption of fuel, &c.; and we now give from the same source, a very useful Statement, bearing on the same points, which was furnished to the Committee by Mr. Macgregor Laird, of Liverpool, the companion of unfortunate Lander in his last African expedition.—ED. M. M.]

STATEMENT.

NAME.	TRADE.	Present Power. Diameter of Cylinder.	Present Power. Length of Stroke.	Present Power. Nominal Power.	Former Power. Diameter of Cylinder.	Former Power. Length of Stroke.	Former Power. Nominal Power.	Length.	Beam.	Tonnage.	REMARKS.
Dolphin	Dublin	48½	4.6	160	44¾	4.6	140	135	22.10	340	Post Office Packets. These three vessels very much improved by the increase of power.
Comet	.. ditto	48	4.6	160	46½	4.6	150	125	22. 6	300	
Etna	.. ditto	48	4 3	160	46	4.3	140	125	22. 6	300	
Thetis	.. ditto	44¾	4.6	140	—	—	—	125	22. 6	300	
City of Dublin Company:											
Kingstown	Dublin and Waterterford	34	3.0	70	—	—	—	—	—	190	
Shamrock	Dublin and Belfast	37	3.6	80	—	—	—	—	—	300	
Liffey	Dublin	40	4.0	100	—	—	—	130	22.	300	
City of Dublin	.. ditto	45	3.6	125	—	—	—	133	22. 4	320	
Mersey	.. ditto	45	3.6	125	38	3.6	90	145	22.	340	
Hibernia	Belfast	45	3.9	130	—	—	—	130	23.	330	
Nottingham	Dublin	45	4.0	130	—	—	—	140	25.	420	
Leeds	.. ditto	45	4.0	130	—	—	—	140	25.	420	
Birmingham	.. ditto	45	4.0	130	—	—	—	140	25.	420	
Ballinasloe	.. ditto	46	4.3	140	—	—	—	140	24. 6	400	
Commerce	.. ditto	47	4.6	150	—	—	—	144	22.	340	
Britannia	.. ditto	48	4 3	160	46	4.3	140	135	24. 6	380	
Huskisson	.. ditto	50	4 9	180	42	4.0	110	140	23. 6	370	
Lansdowne	Loch Dero	38	3.6	90	—	—	—	130	17. 0	170	These two are built of iron; the Lansdowne has been tried, and steams 12½ miles per hour.
Garry Owen	Shannon	36	4.0	85	—	—	—	125	21. 6	280	
Drogheda Company:											
Town of Drogheda	Drogheda	42	4.0	110	—	—	—	130	22.	300	This Company is as good an instance as any of the tried advantages of increasing the power without increasing the size of the vessel much.
Fair Trader	.. ditto	44½	4.6	130	—	—	—	130	23.	330	
Green Isle	.. ditto	49	4.6	170	—	—	—	135	23.	350	
New Boat	.. ditto	53	5.0	200	—	—	—	140	23. 6	370	
Sir John Tobin:											
Gipsy	Waterford	45	4.0	130	—	—	—	140	22. 6	330	
St. Patrick	.. ditto	49	4.6	160	—	—	—	150	25. 0	460	
William Penn	.. ditto	50	4.6	170	—	—	—	160	25. 0	500	
St. George Company:											
Llewellyn	Beaumaris	34	3.0	70	—	—	—	110	18.	170	
Air	.. ditto	32	3.0	60	—	—	—	—	—	150	
Zephyr	Exeter and London	34	3.6	70	—	—	—	115	17. 6	170	
William IV.	Hull and Gottenburg	40	3.6	100	—	—	—	—	—	300	
Superb	...... ditto	43	4.0	120	—	—	—	—	—	300	
Inisfail	Dublin and Cork	43	4.0	120	—	—	—	130	22.	300	
St. George	Dublin	43	3.6	120	—	—	—	135	20.	260	
Herald	Cork and London	43	4.0	120	—	—	—	130	22.	300	
Severn	...... ditto	45	4.0	130	43	4.0	120	142	22.	340	The speed of these vessels very much increased by the additional power.
Lee	...... ditto	45	4.0	130	43	4.0	120	142	22.	340	
Lord Roden	Dundalk	45	4.0	130	42	4.0	110	140	23.	360	
Emerald Isle		48	4.0	150	—	—	—	145	24. 6	420	Building.
Express	Dublin and Bristol	42	4.0	110	—	—	—	135	21.	280	
Victory	Cork and Bristol	47	4.9	150	—	—	—	150	24.	410	
St. David	Glasgow and Dublin	34	3.0	70	—	—	—	125	17. 6	190	
Carlisle Company:											
Solway	Carlisle	36	3.6	80	—	—	—	130	21. 6	290	The Company propose increasing the power of these two vessels to 160 horse.
Cumberland	.. ditto	36	3.6	80	—	—	—	130	21. 6	290	
Carlisle	.. ditto	43	4.0	120	—	—	—	130	21.	280	
Newcastle	.. ditto	48	4.6	160	—	—	—	145	23.10	390	
Countess of Lonsdale	Whitehaven	—	—	80	—	—	—	—	—	250	
St. Andrew	.. ditto	—	—	60	—	—	—	—	—	150	
Union	Maryport	—	—	80	—	—	—	—	—	160	

STATEMENT—*continued.*

NAME.	TRADE.	Present Power. Diameter of Cylinder.	Present Power. Length of Stroke.	Present Power. Nominal Power.	Former Power. Diameter of Cylinder.	Former Power. Length of Stroke.	Former Power. Nominal Power.	Length.	Beam.	Tonnage.	REMARKS.
Glasgow Company:											
City of Glasgow ..	Glasgow	—	—	100	—	—	—	—	—	320	The power of these boats has been gradually increased and found to succeed.
John Wood	.. ditto	—	—	130	—	—	—	130	21.6	280	
Vulcan	.. ditto	52	4.6	190	—	—	—	140	23.	360	
Glasgow..........	.. ditto	—	—	100	—	—	—	—	—	300	
Ailsa Craig	.. ditto	—	—	100	—	—	—	—	—	250	Every new boat, it will be seen, belonging to this Company, has gradually had the power in reference to the tonnage very much increased.
Liverpool	.. ditto	—	—	160	—	—	—	—	—	350	
Manchester	.. ditto	53	5 0	200	—	—	—	150	23.6	390	
Clyde	.. ditto	48	6.0	190	—	—	—	—	—	330	
Londonderry:											
Queen Adelaide ..	Londonderry.......	45	4.0	130	—	—	—	—	—	280	
Robert Napier	.. ditto	54	4.6	200	—	—	—	—	—	360	
New Boat	.. ditto	54	4.6	200	—	—	—	—	—	360	Now building.
New Boat	.. ditto	54	5.0	220	—	—	—	150	23.	380	.. ditto.
Belfast Company:											
Chieftain	Belfast	—	—	160	—	—	—	—	—	400	
Corsair	.. ditto	—	—	100	—	—	—	—	—	250	
New Boat	.. ditto	55	5.0	220	—	—	—	—	—	380	Now building.
Waterford Company:											
Nora Creina....	Waterford and Bristol........	45	4.0	130	—	—	—	140	22.4	330	
New Boat	.. ditto	50	4.9	180	—	—	—	150	24	420	Now building.
Bristol Company:											
City of Bristol..	Waterford and Bristol........	—	—	160	—	—	—	—	—	300	
Killarney	Bristol and Dublin .	—	—	200	—	—	—	—	—	400	
Albion	Bristol and Cork ..	—	—	200	—	—	—	—	—	420	
New Boat	Bristol and Waterford	—	—	200	—	—	—	—	—	370	Now building.
Palmerston	....	—	—	80	—	—	—	—	—	220	
County of Pembroke	....	—	—	80	—	—	—	—	—	200	
Herald	....	—	—	80	—	—	—	—	—	200	
Glamorgan	....	—	—	60	—	—	—	—	—	180	
Bristol	....	—	—	60	—	—	—	—	—	180	
Nautilus..........	....	—	—	50	—	—	—	—	—	150	
Newry Company:											
George IV.	Newry	43	4.0	120	—	—	—	—	—	300	
Henry Bell	.. ditto	—	—	60	—	—	—	110	18.	170	
John of Gaunt	Lancaster	—	—	60	—	—	—	—	—	150	
Dublin and Londonderry Company:											
Thames	Dublin and London	48	4.6	160	—	—	—	—	—	500	
Shannon	...... ditto	52	4.6	190	48	4.6	160	—	—	500	
Londonderry......	...... ditto	48	4.0	160	—	—	—	—	—	400	
W. Fawcett	...... ditto	43	4.0	120	—	—	—	—	—	360	
Royal Tar	...... ditto	55	6.0	230	—	—	—	—	—	600	
Dublin and Glasgow:											
Erin	Dublin and Glasgow	—	—	120	—	—	—	—	—	300	
Scotia............	...... ditto	—	—	120	—	—	—	—	—	280	
				11,045	Horse-power..			—	—	26,880	Tons, or about two tons and three-sevenths to each horse-power.

Statement of Steam Vessels built and altered in the last Two Years; showing the increase of Power in proportion to the Tonnage.

	Power.	Tonnage.		Power.	Tonnage.	
Dolphin	160	340	Brought up	1,985	4,740	
Etna	160	300	Union	80	160	
Comet	160	300	John Wood	130	280	
Huskisson	180	370	Vulcan	190	360	
Lansdowne	90	170	Manchester	200	390	
Garry Owen	85	280	Clyde	190	330	
Green Isle	170	350	Robert Napier	200	360	
St. Patrick	160	460	New boat } London-	200	360	
William Penn	170	500	Ditto.. } derry..	200	380	
Zephyr	70	170	New Belfast boat	220	380	
Victory	150	410	New Waterford	180	420	
Emerald Isle	150	420	New Bristol	200	370	
City of Carlisle	120	280				
Newcastle	160	390		4,195	8,900	....or 2 and 1-7th tons to 1 horse-power.
Carried up	1,985	4,740				

Vessels built previous to 1st January, 1832......6,850 power......17,980 tons, or 2 tons and 5-8ths of a ton to each horse-power.

Vessels built and altered in 1832, 1833, and 1834....4,195 power....8,900 tons, or 2 and 1-7th tons to each horse-power.

General average of all the vessels at work, per annexed Statement, 11,045 power, 26,880 tons, or 2 and 3-7th tons to each horse-power.

Holyhead.

All the packets on this station (excepting a new one, which commenced plying a few weeks ago,) are

about..................240 tons.
and...................100 horse-power.

They formerly had only 80-horse power, but that being found too small, they have been increased to 100-horse power, and make much better passages in consequence.

The new vessel alluded to above is 300 tons, and only 100-horse power, and does not go nearly so well as the others.

Liverpool Post-Office Packets.

Three of these vessels have had increased power, and are all very much improved in speed.

The Dolphin had formerly a pair of 70-horse engines; she has now a pair of 80-horse, and her consumption of fuel is 4 to 5 tons per trip less than it was before.

Leeds.

Average passages for three years, from Dublin to Bordeaux and back....152 hours.
Quantity of fuel consumed per voyage ....114 tons.

Weekly Expenses.

Weekly expenses of a large steam-vessel, including wages, tallow, oil, &c., but not including coals, harbour dues, wear and tear, &c., 40*l.* 11*s.* 6*d.*

1,200*l.* per annum will cover the wear and tear (including new boilers, repairs to machinery, hull, &c.) of a vessel of 400 to 500 tons, and 180 or 200-horse power.

The above particulars are got from Mr. Shair, and are taken from the books of the City of Dublin Steam Packet Company.

Hugh Lindsay, 1st Voyage in 1834.

Bombay to Red Sea (Suez)
$31\frac{1}{2}$ days.
25 days' steaming.

Coals consumed, $13\frac{1}{4}$ tons, Llangennech, per day.
25 days.

65
266

331 tons.

Newcastle coal, 17 tons per day on former voyages.

Water Witch and Norah Creina.

The Nora Creina is 330 tons, and 130-horse power.

The Water Witch was 440 tons, and 180-horse power.

These vessels were built to the same model, as nearly as they could be, by the same builder. The engines were made by the same person.

The Water Witch, in consequence of her great additional power, made much better passages, and consumed *less coal per week* than the Norah Creina.

This may be considered a good proof of the benefit arising from an abundant supply of power.

The Water Witch, for the voyage from Bristol to Waterford and back, 450 miles, and including getting up steam at both ports, consumed about 36 tons coals per voyage.

Troops.

The greatest number of soldiers brought over in one of the City of Dublin Company's vessels, was in the Mersey, 340 tons. She brought 500 soldiers, and their baggage, besides women and children; say a total of 600.

The Commerce, 340 tons, carries 100 horses, men and baggage. The same vessel has brought from Dublin 900 passengers.

Table of Power in proportion to Tonnage, for Sea-going Steamers.

	Tonnage.	Horse Power.	Proportion.	
A Vessel............	200	120	$1\frac{7}{10}$	of a ton to 1-horse power.
Ditto	300	150	2	.. .. ditto.
Ditto	400	180	$2\frac{1}{10}$	.. .. ditto.
Ditto	500	200	$2\frac{1}{2}$	.. .. ditto.
Ditto	600	230	$2\frac{6}{10}$	.. .. ditto.
Ditto	700	250	$2\frac{8}{10}$	.. .. ditto.
Ditto	850	280	$3\frac{1}{10}$	.. .. ditto.
Ditto	1,000	300	$3\frac{3}{10}$	.. .. ditto.

Table of Consumption of Fuel in Marine Boilers.

	Horse Power.	Lbs. Fuel per Hour.	
Under	120	$10\frac{1}{2}$	per horse-power per hour.
	to 160	$9\frac{1}{2}$	.. .. ditto.
	to 200	$8\frac{1}{2}$	.. .. ditto.
	to 240	8	.. .. ditto.

Table of Speed in proportion to Power and Capacity in Smooth Water and Head to Wind.

	Tonnage.	Horse Power.	Days' Coal.	Power.	Days' Coal.	Power.	Days' Coal.	Power.	Days' Coal.
	200	120	6	100	8	80	11	60	13
	300	150	8½	120	12	100	14	80	16
	400	180	13	150	17	120	19	100	23
	500	200	16½	180	19	150	22	120	26
	600	230	19	200	22	180	24	150	26
	700	250	21	230	25	200	28	180	30
	850	280	23	250	28	230	32	200	36
	1,000	3,000	26	280	30	250	35	230	40
Speed	11 Miles per hour ..			. 10 .		. 9 .		. 8 .	
Speed, Head to wind ..	6 .. ditto .. .			. 5 .		. 4 .		. 3 .	

Table to show the Time and Consumption of Fuel in a Steamer of 700 Tons, with four different Powers, on a Voyage of 2,000 Miles.

	Tonnage.	Power.	Time in Hours.	Coal consumed in Tons.	Power.	Time in Hours.	Coals consumed.	Power.	Time in Hours.	Coals consumed.	Power.	Time.	Coals.
	700	250	182	162	230	200	164	200	222	170	180	250	178
Head to wind	700	250	339	297	230	400	328	200	500	357	180	666	476

The vessel with the large power would, therefore, save in fine weather, 16 tons of coals, and against a head-sea, 178 tons. This statement is not merely theoretical; it has proved itself to be true in every instance where a well-proportioned steam-vessel has had her power increased.

THE DAVY LAMP TRIED AT LAST BY A COMPETENT TRIBUNAL.

Sir,—But that the days of wonderment are gone by, the exposure last week of the groundless pretensions of the Davy Lamp to safety, at the London University, would cause some astonishment.

You are, sir, of course aware, though many of your readers may not, that a Select Committee of the House of Commons, of which that intelligent and philanthropic individual, Mr. Pease, is chairman, has been sitting for some weeks past, to find, if possible, the means of preventing explosions and other fatal accidents, of late so frequent in the coal mines of Great Britain. It is not necessary here to attempt a detail of the many interesting matters which the valuable labours of these gentlemen have brought forth, as the whole will, no doubt, be shortly before the public in an official form; the inquiry having terminated as to the further examination of witnesses. It will, however, it is presumed, be highly satisfactory to the mining community, to know that the attention of the Committee has been seriously directed to the question, whether the miner possessed a really safe lamp or not; the result of which is a proof that neither the Davy Lamp, nor any other lamp, hitherto in use, will always protect the workman against the

action of the sometimes highly explosive atmosphere of a coal mine. The tests adopted by the Committee to ascertain this important fact, were most advisedly resorted to, being in their nature such as might be expected in the practical use of a safety lamp. The sound judgment of the Committee in this respect, is remarkably in contrast with that of the persons who have hitherto so pertinaciously supported the pretended safety of the Davy Lamp, by inadequate trials, through its long destructive course. Several newly-constructed lamps, which had been placed before the Committee, were tried, on the occasion referred to, at the London University. They were subjected to the tests, under which the Davy Lamp failed, and with the exception of a lamp invented by Messrs. Upton and Roberts, all proved insecure. The disposition you have constantly shown to benefit both the mine-owners and their workmen, whenever an opportunity presented itself, has induced me to make this communication.

Your obliged and obedient servant,
U. G. R.

August 5, 1835.

THE LATE LONDON AND BIRMINGHAM RAILWAY COMPETITION.

Sir,—It is to be expected that if an individual treads upon another's heels, the aggrieved will either turn round or call out. I may, therefore, hope to be pardoned for so doing.

Mr. Daglish's prize rails and pedestals, described in No. 620, however they may have been approved by one or more of the Committee of Reference, are not, after all, those adopted by the London and Birmingham Railway Directors. Can Mr. Daglish, therefore, have cause to complain at not having received the whole instead of the larger portion of the premium offered by the Directors, when it appears, from their not having adopted his plans, they are not likely to derive any advantage from them?*

The circumstance, however, which leads me more particularly to address you is, that another candidate — whose suggestions have been, and are now being, adopted by the Directors—should be altogether overlooked. The new method of placing the stone sleepers angularly to the line of rail* will, doubtless, be attended with advantage. A stone of 18 inches will present more surface in the direction most required, than a stone of 2 feet can do if placed square to the line of road. I would ask, then, if there be not a *saving* advantage in the proposition? And may not some acknowledgment—if not a crumb or two of the cake—be expected by the originator of the plan, offered, as it was, in consequence of the advertisement issued by the Company? It may be said, "Oh! it is only laying the stone a *little* different, that is all!" No doubt; but so might it have been said when Mr. M'Adam proposed and used broken granite to repair the public roads. Is it not somewhat singular that the advantage, simple as it is, should never have been pointed out before?

I have, however, no wish to cavil; the suggestion is undoubtedly approved: and I should be well pleased were the full advantage of placing the stones in an angular position likely to be reaped by the Company, which, for one or two reasons, however, I fear will not be the case.

Mr. Barlow has taken to *himself* the credit (pages 31 and 92 of his experimental pamphlet) of suggesting the fixing of the centre of the rail to the chair, to admit of its contraction and expansion. His words are:—

> "*I* suggest, as a matter deserving the attention of practical men, that as the bar must necessarily contract, it will draw from that side (end?) which is least firmly fixed, and hence all the shortening will most probably be exhibited at one end, however slight the hold on either may be; and when it happens that the adjacent ends of two bars both yield, the space is 'double.' To avoid this evil, *one of the two middle chairs in each bar might be permanently attached to the rail,* in which case, *the contraction must necessarily be made from each end.*"

Now, what will be thought of Mr. Barlow's candour and fairness when I state, without fear of contradiction, that he has borrowed this suggestion from one of those very competitors whose plans were referred to him for decision, and to

* The premium was offered unconditionally for the best of the forms proposed, whether subsequently adopted by the Directors or not. The question of "advantage" seems to us, therefore, to be here raised somewhat unnecessarily. It is no fault of Mr. Daglish's, though *possibly* it may be a great fault on the part of the Directors, that his plans have not been followed.—Ed. M. M.

* First suggested, we believe, by the writer.—Ed. M. M.

whose attention he so formally recommends it as an idea of his own? The 5th and 7th of my propositions to the Directors were as follows:—

"5. That the round key will keep the rail steady without wedging; and, if fitted in tightly and headed, will admit the expansion of the rail.

"7. That, to secure the correct position, *the centre of each rail is to be firmly wedged to one of the centre chairs.*"

I should not have trespassed so far upon your limits, had not a sense of propriety really demanded it; and did I not feel assured of your willingness to afford every facility to the vindication of the truth.

I remain, Sir,
Yours respectfully,
James Woodhouse.

Kilburn, August 10, 1835.

JOURNEY FROM LONDON TO MARLBOROUGH IN MR. WALTER HANCOCK'S STEAM-CARRIAGE, THE "ERIN."

Sir,—The "Erin" steam-carriage, which was built by Mr. W. Hancock to run on the Paddington-road, and originally called the "Era," (described in your journal, No. 585) started from Stratford on Tuesday morning last, at half-past four, for Marlborough, with a party of gentlemen. Mr. Hancock had attached a small tender to the carriage, containing coke and water sufficient to have lasted us to Reading; but the bar of wood, through which the bolts ran that fixed the tender to the carriage, gave way in Cheapside, and we were obliged to leave the tender behind us.

The carriage reached Hyde-park Corner by 6 o'clock, where we remained about half an hour to take in some more of our party, and proceeded on to Reading, which we reached at 11 minutes past 11 o'clock. The company stopped there an hour and a half and dined; after which the journey was resumed.

The carriage reached Marlborough by half-past 6 o'clock, with no other accident than the breaking of one of the bands of the blower. The total time on the road was a minute or two short of 12 hours, of which 4½ were occupied in stoppages, leaving 7½ hours for travelling the 75, being at the rate of just 10 miles an hour.

No one who has not travelled by steam-carriages can imagine the inconvenience and delay which results from the want of regular and ample supplies of water; the carriage having to stop from 14 to 18 minutes every 10 or 12 miles to fill the tanks by hand-buckets from pumps, with sometimes the additional inconvenience of having to take the supply from some neighbouring stream or pond. While the carriage is stationary, the fire slackens in consequence of the blower being stopped, and it requires about two miles running to get it again into full play. By observations which I made on the road while timing the carriage, I found that the rate of the first three miles, after taking in water, averaged 7½ minutes a mile, whilst the latter part of the distance, till the carriage again stopped for water, averaged 1 mile in 5 minutes. Frequently the men were obliged to use any kind of water they could get; some being filled with duck-weed, straw, and filth of every description, which, of course, very much retarded the generation of steam. The inconveniences arose in the present case chiefly from the loss of our tender, which would have carried us to Reading without any stoppage.

All these delays would, of course, not happen, if water stations, having tanks with large hose, which might fill the carriage in a minute, were provided. There is no doubt, that had such arrangements been made for supplying the "Erin" on the present journey, it would have performed it, including stoppages, in 6 hours; though the carriage was not built, I am informed, nor intended for long journeys, but for such short distances as between London and Paddington.

Mr. Hancock started from Marlborough to return to London on Friday at half-past 5. The carriage accomplished the ascent of Marlborough-hill—the steepest acclivity on the Bristol-road, being full one mile long, and having a rise of about 1 in 7, in 6 minutes, with a stoppage of 4 minutes. The "Erin" reached Reading by 10, and stayed 1½ hour for breakfast. After running through the town we continued our journey, and reached London by half-past 5, being again 12 hours on the road, and having lost nearly about the same time in stoppages as on our journey down.

Our reception on the road was very cordial; there was scarcely any manifesta-

tion of bad feeling throughout the journey; indeed, wherever we stopped to take in water, we had every assistance given us by the bystanders. We were particularly well received at Marlborough, where we stayed two days. The carriage made a trip through the town each day; and Mr. Hancock astonished the inhabitants by the easy manner in which he could turn, stop, or back his carriage. Two gentlemen of Marlborough most hospitably entertained the steam travellers whilst they remained in that town.

Subjoined, I give a table of the performances of the steam-carriage taken from the notes of the gentlemen who timed the carriage.

And remain, yours truly,

R.

London, August 10, 1835.

TO MARLBOROUGH.	No. of Miles.	Miles from London.	Time.	Stoppages.	Time of Travelling exclusive of Stoppages.	Miles per Hour.
			h. m.	h. m.	h. m.	
London	0	0	6 27			
Hounslow	10	10	7 27	0 8	0 53	11 3
Maidenhead	16	26	9 37	0 41	1 29	10 8
Reading	13	39	11 11	0 13	1 21	9 6
Dine at Reading	—	—	—	1 20	—	—
			P. M.			
Newbury	17	56	3 11	0 54	1 46	9 6
Marlborough	19	75	6 23	0 50	2 22	8 0
Total	75		11 54	4 6	7 49	9 6
TO LONDON.						
Marlborough	0	75	5 32			
Newbury	19	56	8 12	0 52	1 48	10 6
Reading	17	39	10 10	0 19	1 39	10 3
Breakfast at Reading	—	—	—	1 30	—	—
			P. M.			
Maidenhead	13	26	1 31	0 46	1 5	12 2
Hounslow	16	10	4 10	0 30	2 9	7 4
London	10	0	5 30	0 25	0 55	10 9
Total	75		11 58	4 22	7 36	9 8

JOURNEY FROM LONDON TO MARLBOROUGH BY MESSRS. MAUDSLEY AND FIELD'S STEAM-CARRIAGE.

The journey from London to Marlborough has been also recently performed by the steam-carriage constructed by Messrs. Maudsley and Field for Sir Charles Dance, Mr. Macneil, and other gentlemen. We extract the following statement of its performances from a letter of Mr. Macneil to the newspapers. It will be seen that the rate of speed realized was nearly the same as in the case of Mr. Hancock's "Erin;" but the time occupied in stoppages was less, owing, no doubt, to better arrangements having been made for the supply of water:—

"Time on the road in going down	8 10 30
Deduct stoppages	2 21 4
Total time while moving	5 49 26

Which gives about 12·86 miles per hour whilst running.

Time returning	11	22	0
Deduct stoppages	4	2	0
Total time moving	7	20	0

Which is rather more than 10 miles per hour whilst running."

ON FURROW TILE-DRAINING.

The quantity of drain-tiles made at different periods, by a tile-maker, and the prices given, were as follows:—

Total for 5 years previous to 1817	23,000,	at the average cost of	25s. per 1,000
.. 1822	120,000	.. ..	19s. ..
.. 1832	3,400,000	.. ..	13s. 9d. ..

The prices here stated, however, are exclusive of the cost of coals, headings, materials, and the use of the kiln-shades and tile-boards. The price is now reduced from the average of 13s. 9d. to 9s. per thousand for making. The size of the tiles when burnt is 14 inches long, 4 high, 3½ base (outside dimensions), and ½ths of an inch thick. The total cost may now be stated as under 14s. per thousand, including expense of buildings, coals, headings, and other requisites. The quantity of tiles required to drain an acre of land by such furrow is 1,500, on an average width of 7 or 8 yards; and the cost of labour in placing them 12 or 14 inches deep in the furrow is about 12s. per acre.

Since the sale prices for drain-tiles have fallen from 40s. to 30s., 25s., and then to 20s. per thousand (although in some districts the price is still high, partly from the want of a better application of labour in making tiles), the quantity used by the public has wonderfully increased; there is a price which compels the public to use them sparingly—and there is a palatable price that leads to general usage. Upon cold, loamy soils, furrow-drained, the increase in the crop of wheat is usually from 16 to 20 bushels, that is, an increase of 4 bushels per acre. Upon better loamy soils, the increase is from 24 bushels to 28 or 30 bushels; and upon rich loamy soils, there are some instances where the increase is from 28 to 40 bushels; this increase has continued for years past. It is most distinctly shown, that on soils where sheep are liable to rot, not any thing of the kind is in existence where furrow tile-drainage is had recourse to, provided there is a reasonable degree of attention paid to the work at the time it is carried on, and in keeping the ditches and outfalls properly cleansed. On all wold, cliff, heath, and light soils, where the substrata are chalk, limestone, gravel, and where the surface-water filters through the soil as it falls, drainage of course is not needed.

There is an able article on the rot in sheep in the last *Quarterly Journal of Agriculture*, wherein it is remarked, that to prevent the rot is better than to cure, but there is not a word about furrow tile-drainage as a preventive.

In the Mechanics' Magazine, No. 618, June 13, 1835, there is a notice of a hand-labour brick and tile machine at Leeds, patented by Messrs. Clark, Longbottom, and Co., by which the tile is produced at one and the same operation by pressure. The expense of grinding the clay is thus saved; and the labour in making so much reduced, that the price for drain-tiles has fallen at Leeds from 14s. to 11s. 6d. per thousand. This important result will doubtless cause a great increase in the demand for drain-tiles, and lead ultimately to the introduction of an uniform rate of expense for them throughout the country. B.

STEAM NAVIGATION—TWENTY MILES AN HOUR!

Sir,—I refer you to the enclosed extract from a New York paper of June last, for an account of the extraordinary performances of the steam-boat "Lexington," which plies between Providence and New York—the greater part of the distance an open and exposed sea-coast —which, if you think proper, is at your

service for publication in the Mechanics' Magazine.

Very respectfully,
Your obedient servant,
AN AMERICAN.

London, August 6, 1835.

"*Fastest Boat in the World.*—The Steamboat Lexington made her first trip to Providence on Monday, and returned yesterday. She is elegantly fitted-up, and so arranged as to be airy and pleasant. But it is not in those respects particularly that she deserves notice, though in them she is probably equal to any other boat. Her superiority is in her firmness and ease in the water, and, above all, her speed, in which we suppose it is safe to say, she surpasses any boat in the world, and has, in fact, reached a degree which was supposed two years ago impossible, and which is calculated to throw some new ingredients into the inquiry respecting the relative value of the various modern improvements in travelling. The Lexington made her passage to Providence in twelve hours and twenty-eight minutes, after deducting eight minutes for stops, and her passage back from Providence to opposite the Dry Dock, in this city, was performed within twelve hours. For a part of the way her speed was twenty miles an hour. The distance from New York to Providence is called two hundred and ten miles. The construction of the Lexington is in several respects novel, and as she acquires her superiority from those novelties, they will be interesting to all persons engaged in the building of vessels. She is 208 feet long, has 22 feet beam, and 11½ feet hold. She is timbered in a manner to give the greatest degree of strength, and is put together with the utmost accuracy and niceness of workmanship. But that which enables her to endure, on so long a line, the immense pressure which bears upon the stem and stern while she is forced through the water at so rapid a rate, is, that the deck is an arch, thus bringing the pressure against the *ends* of the timbers and planks instead of against their sides. The stroke of the piston is 11 feet, the diameter of the water-wheels 24 feet, and the revolutions 21 to 23 a minute. The boiler and the weight of machinery, as far as possible, is placed in the hold. The Lexington was built by Bishop and Simonson, under the direction of Captain Cornelius Vanderbilt, her owner. Her construction exhibits great knowledge of mechanical principles, and a peculiarly bold and independent genius. We ought to add, that notwithstanding her great speed, there are no wood-piles necessary on deck, and the expense of fuel is not more than half so great as in an ordinary boat."

NOTES AND NOTICES.

THE LETTERS PATENT AMENDMENT BILL was, on the motion of *Mr. Tooke*, read a second time in the House of Commons on Thursday last.—*Mr. Mackinnon* opposed it in a very sensible speech, on the ground chiefly of its leaving untouched that worst evil of the existing system, namely, the enormous expense; and pronounced it to be altogether "a miserable, bungling piece of legislation."—*Mr. Parker* regretted that the measure was not more comprehensive.—*Mr. Wilks* suggested the propriety of allowing limited patents, as in France.—*Mr. Wallace* supported the Bill, but trusted that a more comprehensive measure on the subject would be brought forward next Session.—*Mr Lennard* regretted very much that this Bill fell so far short of what the public had a right to expect.—*Mr. Potter* thought that they might still make this measure more comprehensive in Committee.—The *Lord Advocate* of Scotland admitted that the expense was far too great, and that all fees connected with the taking out of patents should be reduced; but he recommended the House to pass this Bill, as it would form a foundation for more comprehensive and necessary measures next Session.—*Dr. Bowring* supported the Bill, as one step in the right way.—*Mr. Pryme* was anxious to reduce the expense, but as at this late period of the Session they could not pass a general measure, he would support the present Bill.—*Major Beauclerk* thought they might as well at once introduce clauses into the Bill for lessening the expense in granting patents.—*Mr. Mackinnon*, though he felt as strongly opposed to the Bill as ever, would not, under the circumstances, obstruct its progress.—The Bill was then read a second time, and ordered to be committed on Tuesday next.——So far well! All are agreed that it is a most deficient Bill, and that the only apology for passing it will be, that it may lead to something better next Session, that is, by making, as we said last week, the bad much worse. The unanimity of opinion on the point of expense is particularly gratifying. On every former occasion when the Patent Laws have been under the consideration of Parliament, the danger of making patents cheap has been a favourite theme; but no one seems disposed to risk his character for common sense by talking in this way now. This is a great point gained. The relief sought for cannot now be far distant.

Colonel Macerone requests us to state, that "being at a distance from town, without access to dates, drawings, &c." he is obliged to defer till next week his reply to Mr. Ogle.

Communications received from Mr. Coathupe—Vindex—Rusticus—C. Z.—Marcellus—Mr. Hendrie.

Erratum in Mr. Herapath's Communication:—P. 356, col. 1, line 23, for "whose compass is interest and gold, the pole to which it points," read "whose compass is interest, and gold the pole to which it points."

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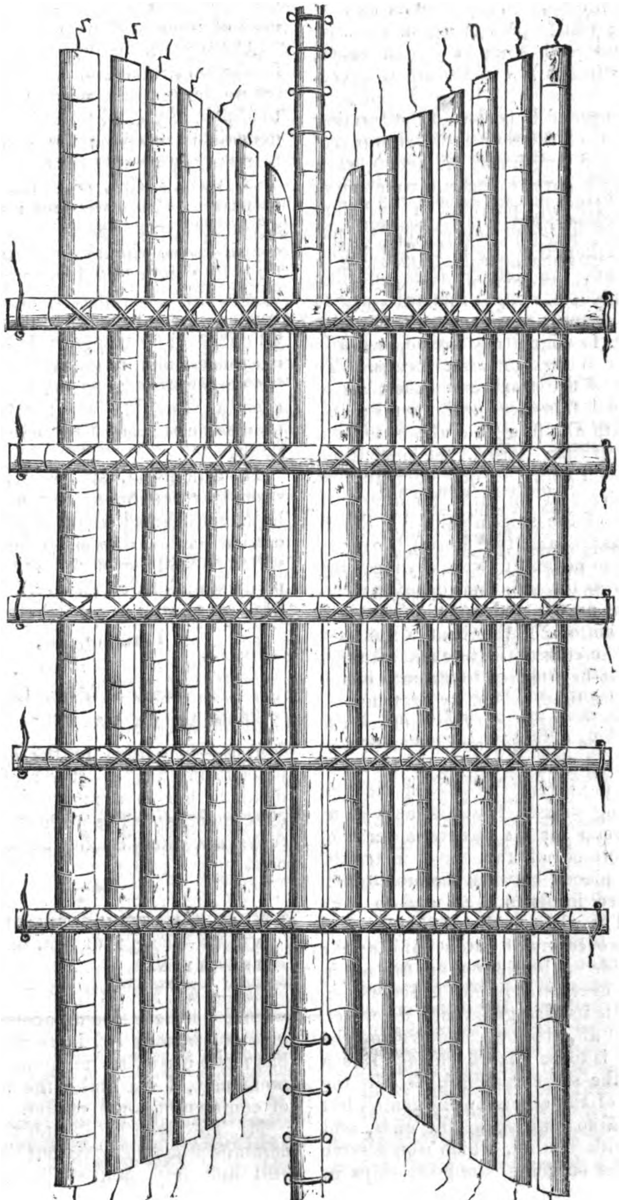
MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

No. 628. SATURDAY, AUGUST 22, 1835. Price 3*d*.

WALL'S INDIA-RUBBER LIFE-BOAT.



INDIA-RUBBER LIFE-BOAT.

Sir,—Having observed some notice of boats having been constructed of India-rubber, in some of the recent numbers of the Mechanics' Magazine, I beg leave to forward to you a drawing and description of a life-boat partly formed of that material; which plan I communicated nearly two years since to a gentleman, whose testimony I can refer to if necessary.

It is purposed to construct the framing of the boat of tubes of India-rubber (of any required length and diameter), each secured by a cover of patent water-proof canvas. Having provided a sufficient number of these, in proceeding to put them together, they are to be laid flat on the ground, the longer ones outside; across which, at certain intervals, are to be laid shorter tubes of somewhat greater diameter, to which they are to be firmly lashed by thongs or other means. To each end of the transverse tubes, are to be attached thimbles and lanyards; and underneath all, fore and aft, is to be a tube longer than those at the side, fitted at each end with the necessary number of thimbles and lanyards for attaching the ends of the side-tubes. All things being thus prepared (see figure), the cross-tubes are to be bent upwards by receiving the lanyards through their opposite thimbles, and drawing them together will give the bottom of the boat a rounded form. The ends of the fore and aft tubes are then to be attached to the ends of the long centre-tube, when, by drawing all parts closely together, the ends of the vessel will be secured, and the stem and stern formed like those of a whale-boat. In order to prevent the sides of the boat from being pressed inwards, as well as to form seats for the rowers, a series of circles, formed of the same materials, are to be placed between the cross-tubes, and lashed firmly to them and to each other. The whole is then to be enclosed within two covers of patent canvas; the one outside to be finer than the other, and paid over with liquid India-rubber, to facilitate its passage through the water. Outside of all, about six inches below the gunwale, is to be placed on each side a tube of the same material, double the diameter of the others, in the centre, but tapered off to nothing at the ends, and covered with leather, which would serve as a fender on going alongside ships in distress, and, together with bags of water for ballast, would effectually prevent the boat from being capsized. To obviate the chance of any of the tubes being wounded, and so permitting the escape of the air, it is proposed to have transverse partitions of India-rubber placed in each of them at short intervals.

Although the system is now proposed for the construction of a life-boat only, I see no reason why it might not be adopted to almost any extent for the purposes of general navigation; nor can I at this moment say what limit could be assigned to a vessel's size, constructed of such materials. This principle might also be substituted with great benefit for the copper-tubes, which have been suggested, for giving increased buoyancy to vessels, by placing them between the timbers and beams. Such tubes as the above, in addition to their superior buoyancy and cheapness, might, in the event of distress or shipwreck, form a secure raft, or even a vessel, in which the crew and even some portion of the cargo might be saved.

In conclusion, Mr. Editor, I would strongly recommend that a small life-boat, constructed on these principles, be carried on board every sea-going vessel, which would be of the utmost use in many situations of danger. Why not a life-boat as well as a life-buoy?

I remain, Sir,
Your humble servant,
ROBERT WALL, Lieut. R.N.

London, August 2, 1835.

P.S.—The tubes in the drawing are placed somewhat apart to render it more distinct; but in a model they would be close together. The upright ends of the tubes are intended for thowels for the oars.

MR. OGLE'S STEAM-CARRIAGE EXPERIMENTS.—REPLY OF MR. OGLE TO MR. TREVELYAN.

Sir,—As Mr. Arthur Trevelyan, to whom, I believe (being acquainted with many of his family), I am not unknown, has made use of my name not very ceremoniously, I shall take the opportunity of commenting on his letter.

Mr. Trevelyan in a letter of two short columns pronounces his fiat on six difficult and important subjects. Of Mr.

Trevelyan's talents no one can doubt, but, in such an imperial strain to—

> "Assume the God,
> Affect the nod,
> And seem to shake the spheres,"

is going a little too far in these days. If, when thus sublimely occupied in despatching with a few dicta or nods, subjects embracing much information in natural philosophy, he unquestionably exhibits a very small quantity of the requisite knowledge, he must expect that some of those whose names he publicly parades will deny his divinity, set his dicta at nought—smile at his nods, and revolt at the attempt to make his opinions laws. His fourth dictum, which is that in which I am more immediately interested, is in these words:—

> "Steam-carriage Inventors: — Gurney, Dance, Ogle, Macerone, Russell, &c., have all talked much of their success, and of the wonders they had performed, or were to perform, but as yet what have they done? Hancock boasted none, and has done a great deal; the slow motion which he has applied is a great improvement, which any practical mechanic will at once see."

This is not a good-natured paragraph, and shows but little knowledge of the subject or its difficulties. Gurney has withdrawn from the arena—Dance has, I believe, turned over his carriage to Mr. Macneil and others — Gurney's boiler, much improved by Field, has been, with some excellent machinery, put into a great drag, and has lately worked powerfully and well to Reading, Marlborough, &c. Both wheels are always kept set, and there are no means of un-geering them in turning, which endangers the axle; a mechanical fault which the talents of Mr. Field will probably remedy. The objections to drawing passengers are numerous: dust, ashes, and carbonic acid gas must affect the eyes, noses, and mouths of those who are in the carriage behind. Ascending steep *slippery hills*, I am not satisfied this drag will always do its duty; and, descending a very slippery one, the drag might swerve, and, perhaps, cause serious accidents. Russell's boiler exploded, and was justly expelled Scotland. The machinery, though very pretty to look at and very compact, I think inefficient, excepting on a flat, smooth road. Hancock has done much; the slow motion for drawing heavy weights, or ascending very steep hills at a slow pace, I think likely to prove serviceable; but there are mechanical objections, of which Mr. Trevelyan, without experience, can know nothing. With regard to myself, I can only say, I never "boasted," (and I never heard any one who had unfortunately embarked time and money in steam-locomotion, but Colonel Macerone boast)—I have travelled some of the most hilly and difficult roads in England, and though I have met with accidents in detail, and stoppages from the inattention of the men, and sometimes from the formation of clinkers on the bars, I know that I have ample powers to go at any required speed at any season of the year—perfect safety from explosion—more safety than any vehicle drawn by horses,—and, as far as I can judge, such durableness, as to make me think very lightly of the usual remarks on steam-carriages "being likely to be always out of order." Why, Mr. Trevelyan may ask, do you not commence operations, and place your vehicles on the road? The answer is very simple—*want of sufficient money for such extensive outlays*. I have expended years of labour and large sums, both necessary to bring such undertakings to a practical state. After travelling from London to Southampton, and thence to Liverpool, I expected support, and reaped expense and persecution. It was expected that the journey was to be performed in a day! (it might be in a long summer's day,) but the axle, *for which I had paid fifty guineas*, was infamously made, and gave way before I reached Oxford. Though the efficiency of the power and the safety were unequivocally proved by the rate of travelling and the elevation of the hills, the breaking of the axle was considered a complete failure, and no support was given me; and Colonel Macerone, in particular, in his scurrilous and disgraceful pamphlet, ridiculed me for the time I expended on the road. Whatever accidents happened from the bad axle (the malicious act of some one plugging the suction-pipe, by which the boiler failed to be supplied with water and was made red-hot, which caused all other delays), not once were we deficient in power. Though the vehicle, with a new axle, ascended, at ten miles an hour, the fresh made trembling embankment at St. Helen's, and with an injured boiler, from which a section had

been taken, affording the greatest proof of power, safety, and command ever yet given by a steam-carriage, it was not deemed sufficient. Though, after being severely wounded, I steered that vehicle in the depth of winter from Liverpool to London over bad roads and under every disadvantage, and with another section of the boiler taken out, more yet was required by those who professed their readiness to support the undertaking. The only benefit I reaped by such intense exertion was to have the mortgage on my factory foreclosed, and to find myself driven from my home and my county, and to see all the plans I had laid destroyed. I have still persevered, and in a stable, without (until very lately) even a foot-lathe, I have prepared two vehicles (the body of one of them is not yet in my possession), and made two boilers for them, which, for perfection of workmanship and superiority of structure, I fearlessly challenge the whole mechanical world to produce any that can compete with them. Unless an individual is possessed of considerable wealth, he cannot carry so great an undertaking so fully into operation, and, at the same time, support his establishment in accordance with his grade in society, without endangering his credit, and fearing even worse consequences. Mr. Trevelyan has now the answer, and I add, that if ten (or a less number) gentlemen will raise a sufficient sum and pay every expense, including that of myself and servants, I will place the great splendid vehicle I have in a vessel, take it as far up the Rhine as possible, and then cross the Alps by the Simplon, and go on to where they like. I would, were I rich enough, do it myself instanter.

The time is not far distant when railways (excepting very short ones, like the Greenwich) will be found profitable only to engineers, lawyers, and managing directors. The Liverpool and Manchester pays the original shareholders almost 9 per cent., the present purchaser about 5. No two points in the kingdom can command an equal traffic; 9 per cent. is not enough, considering the quality of the security. Let us see the time required to go from Liverpool to Manchester by the railway:—

	Min.	s.	d.
From the centre of Liverpool to the railway in an omnibus	20	0	6
Waiting for the starting of train, &c.	5	0	0
Time on railway	90	6	6
From station at Manchester to centre of town	20	0	6
	135	7	6

Three changes of vehicles, &c., and 2¼ hours expended in a distance of 31 miles, at the charge of 7*s*. 6*d*.

Let the road be in good condition through Warrington, and the steam-carriages will run it in as short a time for 1*s*. 6*d*. less, and without any changing. When this takes place—*and it will*—what becomes of the railway shares? They will not be worth 25*l*. per share. If this result may be anticipated on the Liverpool and Manchester, what will ensue on other railways? Can it be supposed that coach-proprietors, innkeepers, carriers, *persons who have lent money on the trusts* (a very serious consideration to those who have no other security than the tolls), and all concerned on the common roads in the transit trade, will be silent and sit still? Be assured that very soon they will begin to work for their own preservation. Hills will be levelled; soft roads made hard; water and coke stations prepared, and locomotive-carriages ply, on the roads, and beat in speed, comfort, safety, and cheapness, all the railroads, and return a profit to the Companies who work them greater than any undertaking with which I am acquainted. The coachmen are the fittest men to steer the vehicles; every horse-boy and helper will be required; and the traffic to places like Tunbridge, Margate, Bath, Southampton, &c., facilitated and increased, to the benefit of every body, and not exclusively the shareholder and employés of railway-proprietors.

The coal-owners will be materially benefitted when steam-carriages are established. Suppose a steam-carriage to consume one bushel of coke per mile, and to require a supply for 50 miles each day, and to work 313 days per annum, it would require 870 chaldrons a year, which being made at the pit-mouth of small coal, would prove a very profitable commodity. Suppose that coke for 2,000 miles a day were required from Northum-

berland, the demand would be about 30,000 chaldrons a year; an object worthy the attention of the coal-owners.

I am, Sir,
Your obedient servant,
NATH. OGLE.

58, Baker-street, Portman square.

[Although we readily give insertion to Mr. Ogle's vindication of himself and his steam-carriage speculations—feeling much for the personal sacrifices they have cost him, and admiring not a little the indomitable spirit with which he bears up against them—we need scarcely observe, that we differ altogether from him in regard to the comparative merits of steam-travelling on railways and on common roads. We think the advocates of the latter do themselves no small harm by indulging in comparisons of this sort. Because railways thrive, it is not to follow that common-road steam-carriages should be abandoned. Surely there is ample room for both—not perhaps as competitors, but certainly as auxiliaries. The railway system would probably be found to answer best for long lines of communication, and the common-road steamers for short cross and branch lines. Mr. Ogle thinks short railways, such as the Greenwich, likely to be the best; but this is against all experience and all sound locomotive doctrine. The Liverpool and Manchester Railway (supposing, for argument sake, all Mr. Ogle says of it be correct), does not furnish a fair criterion by which to judge of other railways. It cost more than any other railway, with one or two exceptions, is ever likely to cost; and it is worked, also, at much greater expense. It is said, moreover, to be under the influence of certain sinister influences (see Mr. Gray's letters), which cause it to be less profitable than it might be. Competition between a well-constructed and well-managed railway and common-road steam-carriages must ever be considered out of the question, as long as it is impossible to deny that the friction in the one case is, at the least, a dozen times greater than in the other.—ED. M. M.]

AEROSTATION.

Sir,—I feel much obliged by your so promptly inserting my letter on "Self-acting Machinery," and hope you will not think me troublesome if I make a few remarks on aërostation, which, I think may not only be of use to others, but also be serviceable to myself:—as, if I *can* say something to the purpose, it will make my assertions (p. 300,) more easily credited, and give me some weight in the opinions of the mechanical world. I shall first point out what I consider to be improper in the construction of the "Eagle," and then advance some ideas of my own on the subject. It appears that the usual weight of the air near the surface of the earth, is 1¼ ounces per cubic foot, or 800 times less than that of water! Therefore a vessel *devoid of air* must ascend, if not held down by a preponderating weight; consequently, to raise apparatus and a man, whose united weights shall be eleven stones, there must be a vacuum equal to 2,000 cubic feet to cause them to float in the atmosphere. Now I presume that *vacuum* must be specifically lighter than *gas;* therefore, if it takes a vessel containing 2,000 feet of vacuum to lift 154 lbs., it must take more space of balloon when inflated by gas to do the same.

I do not pretend to be infallible, therefore my ideas may be wrong, and if so, with all humility I stand corrected; but if I am right, the "*European Aeronautical Society*" will find they have *mis*calculated, and instead of manning their vessel with a crew of seventeen persons, she will be scarce able to rise with 500 lbs., including the weight of the vehicle; and the higher she ascends, the less able will the atmosphere be to support her! Especially if carburetted hydrogen be used, as it is much heavier than hydrogen itself.

I perfectly agree with Mr. Baddeley, that the proprietors have acted somewhat imprudently in fitting up an experimental balloon on such a large scale, when a small one would be more easily managed, —would sufficiently prove or disprove the correctness of their theory, and be attended with less expense. The disproportion of the machine (7,000 feet) to the load intended to be carried, makes me imagine the proprietors either have not understood, or have not taken the trouble to think about it; or else have not designed the "Eagle" to soar in the air at all! I do not like the idea of the

last bursting *just as t was ready to ascend*. It could easily be contrived, and smells very like a hoax.

The "Eagle" seems to be constructed, with respect to the steering apparatus, on the same erroneous principle on which, I believe, *all* aërostatic machines hitherto have been made; and nothing can account for the hum-drum sameness of manner which may be traced through all the stages of aërostation, but the opinion that men of *real mechanical turns* have never yet lent their minds to the study of that science. Wishing to *steer*, they attach their rudder (propeller, sails, or what else they use for that purpose) to the car, which being so much inferior to the balloon in point of magnitude, *can have* no sensible effect on it (further than a tendency to upset it, if caught by a sudden squall), especially as it is not *firmly, unbendingly* fixed; but only by flexible cords, tightened by the weight of the aëronauts! It is like attempting to turn a carriage by some steering machinery connected with the fore-wheels, while the horses which drag it are running in a direct line. Surely the easiest way is to guide the horses, and the carriage will follow.

In making an aërostatic machine, I would recommend that the inflated part, or balloon, should be made in the form of a double convex glass (it needs no drawing to illustrate this); and round the edge attached to netting should be a hoop, from which the car should be suspended. I mean, the convexity of one side should be next the heavens, and the other next the earth, so that the car should hang precisely under the centre or globular part of the whole. To the edge or hoop at each side I would have some light poles, with sails on them, adjustable by running lines from the car, that the aëronauts should not by much moving disarrange the centre of gravity; behind, exactly between the sails, should be placed the rudders, also under the control of the helmsman in the same manner. The load should be proportioned to the buoyancy of the balloon, else the travellers will be tossed about as I have seen the tail of a paper kite, when it has been either *too short*, or *too light*. Instead of using propellers *as yet*, I would search for currents of air as near the direction I wanted to be as possible; which might be ascertained by letting out from time to time a sheet of paper, the four corners fastened by threads to a piece of ballast parachute-wise, and, by "tacking" occasionally, I think the voyagers might come pretty near their mark.

Instead of gas, which is expensive, and cannot at all times be had, I would use air rarefied by heat; a small, light stove might be fixed in the car, and the heated air or smoke conveyed up into the balloon by a flexible tube, in such a manner that an accident from fire could not happen. By a damper the "feed" could be stopped off or put on, to allow the balloon to descend or ascend at pleasure. I do not bring heated air forward as any thing new, for I am aware that Montgolfier ascended from Paris more than once by means of it. In case of accidents short of actual fire, this shape of balloon will act as a parachute, and so diminish that rapidity of descent which would otherwise cause the loss of life.

Perhaps a cheaper and more available mode of ascent would be to make a light frame of steel rods, the same shape as above, covered with netting, and capable of bearing a pressure of 12 or 13lbs. per inch. Cover this with varnished silk, air-proof, and by an air-pump exhaust it. It may be fitted up in the same manner with respect to steering as above. When the idea first struck me, I thought I had hit on something quite new; but on looking over some books, I found that the celebrated Friar Bacon had hinted something of the same kind in the middle of the 13th century. This, in my estimation, seems the best, readiest, safest, and cheapest mode of transit, and ought to be tried. By this method the machine might be worked to the exact gravity of the air, and be wafted on the breeze without materially rising or falling. For descent, air might be speedily let in by a valve or cock, and the voyagers might be lowered to the earth as gently as they could wish. Apologising for this lengthened detail,

I remain, Sir, yours respectfully,
WILLIAM PEARSON.

Bishop Auckland, August 7, 1835.

P. S.—I have noticed the few words (kindly, no doubt,) meant for me by S. Y.; but his proposition does not exactly meet my views: I feel obliged to him though all the same.

TO THE UNIVERSAL POWER.*

God of the Persian!
Who worshipped thee under
The Moslem's aversion,
In love and in wonder!
Who typed thee as Fire,
But knew thee in truth
In thine attributes higher,
Through all nature's growth.
Bountiful Heat!
Parent of motion!
Swift are thy feet,
As a bird of the ocean.

Soul of the solar world!
Spirit of bliss!
Thou who hast lightning hurled,
Lighted Love's kiss;
The universe moving,
Latent or present,
Hating or loving,
Ancient or recent;
Known under many shapes,
Wonderful Heat!
With thee, each heart leaps;
Without thee, none beat.

Where fierce volcanoes flash,
And foams the rushing river;
Where avalanches crash,
And trembling mountains quiver;
Where wild tornadoes hiss,
And pealing thunders roar;
And forked lightnings kiss
The desolated shore;
Where Ocean's mounting waves
Sweep the earthquake-riven land;
There, Heat hath bid his slaves
Show the wonders of his hand.

Where the bellowing cannon,
Man made, unmakes man;
Where Fever lays her ban on,
Withering up Life's span;
Where steel with steel is meeting,
As human demons close,
And human hearts are beating,
With hate, no mercy knows;
Where the poisoned gases
Ride the wild simoom,
In the desert-born oases,
Heat hath made his home.

In the flint's hard heart he sleeps,
Till the blow awakes his ire,
When the flashing spark upleaps,
And he dons his robe of fire;
In lambent flame first crawling,
The lowly slave of man;
Anon in power appalling,
He grasps a wider span;
Where the fire-damp rages,
A tyrant's form he takes,
And then in steam assuages
The misery he makes.

On the crest of the ocean-tides
How he rejoices!
How on Love's wings he rides,
Warms lovers' voices!
In the buds of the young flowers,
Mark how he nestles!
In the trees, and the leafy bowers,
Hark how he rustles!
With the swift steed he hies on
In arrowy flight;
With the wild bird he flies on,
Like meteors by night.

Spirit of Matter!
Beautiful Heat!
Who bidst atoms scatter,
And then again meet,
To give forth new forms
To the varying Earth,
While Harmony warms
At each beautiful birth;
Without thee, Life lives not,
And Death himself dies;
Light or sound the world gives not,
To mark how Time flies.

JUNIUS REDIVIVUS.

* The word "power" is here used in the mechanical sense. I premise this to save trouble to those whose profession it is to hunt out "material" heresies.

LEVER AND SPRING BALANCES.

Dear Sir,—The public are already indebted to the ingenuity of many for various contrivances adapted to the purpose of weighing. Some have vastly improved the conveniences of the old-fashioned beam. Others have devoted their attention to supersede the employment of weights, by the use of oval or spiral springs, and have produced very effective and perfect instruments, with all the accuracy necessary for their intention,—such as Marriott's Dial, and Salter's Spring Balance. But no person has yet availed himself of the effects which are to be derived from the union of the two principles already adopted. It is then, with all due deference to the better judgment of others, that I propose a machine of very easy manufacture and small expense, by combining the lever with the spring balances of Marriott, or Salter, which appears to offer many advantages over either used alone.

Fig. 1.

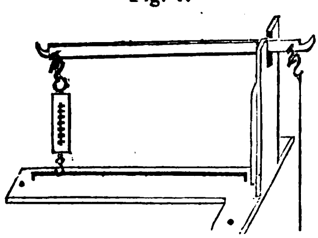


Fig. 1 represents the arrangement for heavy weights, where we will suppose the distance from the fulcrum to the point of suspension to which the spring balance is attached, to be eight times the distance of the fulcrum from the point to which the weight is to be suspended. Salter's balances, graduated to weigh 24 lbs., and whose cost is about five shillings, will then weigh 192 lbs., and each ¼ lb. division will indicate 2 lbs.

Fig. 2.

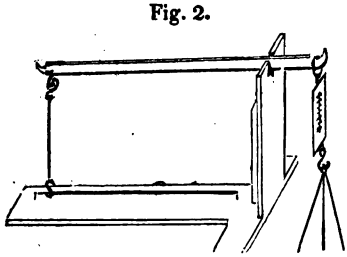


Fig. 2 is the reverse application, and may be used for light weights. Of course each ¼ lb. division will then represent only ½ oz.

Fig. 3.

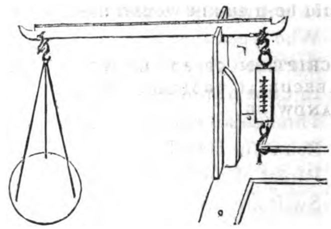


Fig. 3 is merely the conversion of the lever to a simple hook for supporting the spring balance when used in the ordinary manner for immediate purposes.

It is obvious that with a combination of this kind, and using one of Marriott's Dials calculated to weigh 2 cwt., we may readily make it available for weighing a ton, and thus have not only the perfect use of the dial itself when detached, but a machine capable of weighing very heavy packages without weights, thereby avoiding the expense of such weights, the trouble of removing them, and the risk of a false computation.—Yours, &c.

Charles T. Coathupe.

Wraxall, Somerset, August 11, 1835.

LONDON AND BIRMINGHAM RAILWAY COMPETITION.

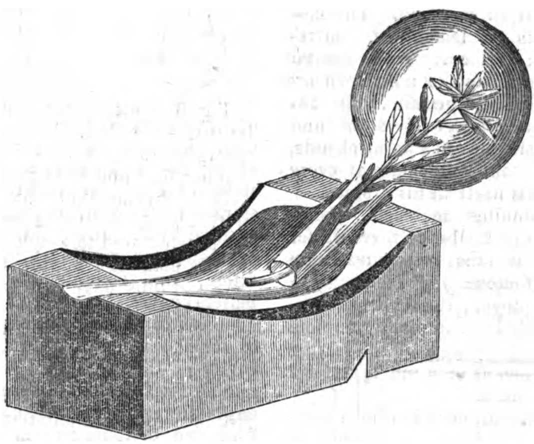
Sir,—The Directors of the London and Birmingham Railway Company having chosen me as one of their umpires for awarding a single prize where there were nearly seventy competitors, it was to be expected that many of those who failed of attaining it would be dissatisfied with the decision, and that it might lead to letters and observations, which, as far as they might impugn only our judgment, it was not my intention to reply to; but Mr. Woodhouse's letter in your last number, relating to a matter of fact, requires to be noticed. He states, that one of the suggestions I have offered was first made by him, and that it ought to have been so stated, to which I readily assent, and I certainly should have so stated it in my report, had I at the time been aware of the fact. It is true that the suggestion was made in Mr. Woodhouse's description, but it may be conceived that two months after reading over seventy statements and propositions from different

parties, some points might easily escape recollection without any want of candour. The suggestion is at present untried, and, I have no doubt, by many considered of questionable utility. If, however, it should be tried and found useful, I very cheerfully concede all the merit of it to Mr. Woodhouse, who is certainly right as to the fact, although quite mistaken as to the motive.

I am, Sir, yours, &c.

PETER BARLOW.

DESCRIPTION OF AN ECONOMICAL AND CONVENIENT METHOD OF CONSTRUCTING MERCURIAL TROUGHS, &c. BY W. H. WEEKES, ESQ., PHILOSOPHICAL LECTURER, SANDWICH.



To the celebrated Priestley, the justly revered founder of pneumatic chemistry, we are also indebted for the introduction of the use of mercury as an eligible and accurate agent of manipulation in various experiments with the gases. Owing to the heavy and expensive nature of the mercurial fluid, it becomes important to render the troughs and other vessels, by means of which it is employed, as small and portable as the general character of the experiments to be performed therewith will possibly admit. Blocks of hard wood, carved and shaped with no inconsiderable degree of labour and expense, appear to have constituted the first mercurial troughs of the pneumatic chemist; to these succeeded marble, cut and polished, in all probability, in a still greater ratio of cost and pains. Subsequently, the ingenious philosophical instrument-maker, Newman, presented the scientific world with his elegant and valuable apparatus for such purposes, formed of varnished cast-iron, the use of which is now pretty generally adopted by experimental chemists.

Few persons, I am persuaded—whatever might have been their first views—can have entered with true philosophic ardour and perseverance upon a series of *original experiments*, without soon perceiving the necessity of frequent changes in the mere *form* of their apparatus; and I believe it may also be safely asserted, that few circumstances tend more decidedly to the success of a course of experiments than a facility of contriving, mounting and adapting apparatus to combat emergencies, and meet the special objects of the experimentalist. By such expediency are expenses, often formidable enough in themselves to cut short the career of investigation, avoided, and a series of laborious and valuable researches brought to a successful termination: it is, therefore, obvious that whatever means will conduce to effect the accomplishment of our scientific pursuits upon the neatest, most simple and economical principle, cannot fail—as it tends to promote not only the objects of science, but to increase the number of experimentalists—to enhance the joint-stock of facts from which philosophy draws materials, and deduces conclusions that ultimately enable her to unlock the hidden mysteries of nature. Upon the

adoption of such views, it becomes desirable that all who are devoted to scientific researches should communicate freely such facts and contrivances as necessity, experience, or chance may have rendered familiar to them. Actuated by this principle, I shall now describe a kind of mercurial trough, which I have, during several years, rather extensively employed in various ways with entire success and satisfaction, so far as respects the utility of the apparatus in question. The cost of this trough is too insignificant to require mention; and every experimental chemist who possesses the most ordinary share of mechanical ingenuity, may supply himself therewith in a few hours, and thus vary the form as often as he pleases, in order to meet the exigencies of every case as it presents itself to his progress.

Newman's smallest mercurial trough requires the use of 20 lbs. of mercury for ordinary manipulations; but by attention to the *form and capacity of the cavity* in the trough employed, the experimentalist will be enabled to command complete success in a great variety of interesting researches, by means of a much smaller quantity of the fluid.

Let us suppose an occasion for a mercurial trough, the block or outline of which shall require to be a parallelogram eight inches in length, four in depth, and three inches wide—(vide engraving). We proceed to its fabrication as follows: Fasten four thin pieces of deal together by means of small brads or otherwise, so that the space included by them shall represent the aforesaid parallelogram: these boards are now to serve the purpose of a case or mould. Now take two parts of common whiting (prepared or washed carbonate of lime), one part of plaister of Paris (sulphate of lime) fresh burnt; mix these by the addition of water to the consistence of a thick cream. The inside of the deal mould being previously oiled to prevent adhesion, pour in the mixture until the mould is full, and leave it at rest for a few hours in a rather warm and dry atmosphere. When the block is turned out of the mould, the requisite excavations may be made with great neatness and facility by the aid of two or three gouges and chisels, and the work afterwards finished with the assistance of a flat file and a few pieces of glass-paper. As soon as this is done to the satisfaction of the operator, the trough is to be well brushed over with good linseed oil; and this operation should be frequently repeated until no more oil is absorbed. If the work be left for a day or two to dry and harden, it will be found to present an appearance similar to Wedgwood's ware, is as easily washed and kept clean, resists a considerable blow, has no affinity for mercury, and is light, portable, and convenient.

The accompanying figure represents a mercurial trough, made several years since, and which has been frequently in use, during the summer months, since its formation, as above described, nor has it suffered the slightest change from exposure by day and night to the variations of the atmosphere and other contingencies. It was originally constructed expressly for the purpose of verifying, by a series of actual experiments on the respiration of plants, an ingenious theory, entitled by its author (Mr. Thomas Pine, of Maidstone, in Kent) "Electro-Vegetation," and which only requires to be better known, in order to insure it the adoption of natural philosophers and men of science generally. An idea of the cavity of this trough, I think, will be readily formed from an inspection of the engraving: it requires not more than from ten to fourteen ounces of mercury to charge it for any manipulation to which it is adapted. From the left-hand end of the trough, a groove, cut by a small gouge, descends to the central oval cavity containing the mercury: in a similar groove of the opposite end rests a bolt-head receiver, the globular part of which is about five inches in diameter, the orifice of the neck being immersed in the fluid, and a small branch from a growing plant or tree brought down the left-hand groove is easily bent to the course of the trough, and continued onward to the receiver. The mercury now acts as a valve to cut off all communication with the external atmosphere; and after a sufficient lapse of time it will be at the option of the operator to ascertain by a proper mode of testing, any change in the gaseous contents of this portable laboratory. The neck of the globe may be firmly secured by a piece of tape or list passed over it, and continued along a groove cut under the bottom of the trough, while the latter may rest in security by its own weight upon a stool, block, or other convenient means of support.

W. H. W.

August 2, 1835.

THE HOUSE OF COMMONS AND THE STEAM-CARRIAGE PROJECTORS.

Sir,—When may we expect an abstract of the evidence (for evidence it is to be supposed there was) taken during the *present* Session of Parliament on the subject of Mr. Gurney's claims to a national reward? The anxiety of your readers for its perusal has naturally been increasing ever since you informed them of the astounding fact, that the Committee had recommended a grant of *sixteen thousand pounds* to be made by way of a compensation for Mr. Gurney's labours. The evidence given last Session was so far from justifying the recommendation of so lavish a grant, that it only served to convince those who attentively considered it, that Mr. Gurney had no claim on the public purse for a single farthing; extraordinary, therefore, we may naturally conclude, must be the nature of the testimony which has since been produced. Unless, indeed, it be of a most extraordinary character, and very, very different from all that preceded it, the conviction will be irresistible that the reformed House of Commons is, at least, quite as easily to be gulled as any House of Commons of the old school; albeit, they were but too prone to throw away the public money on quacks and pretenders, provided they possessed the essential qualification of a thorough, unblushing impudence, in trumpeting forth their " claims."

It is hard to conceive, before seeing the Report and Evidence, on what possible ground Mr. Gurney is adjudged worthy of the *trifling* sum the Committee would award to him. Is it because he has succeeded in proving the practicability of economical travelling by steam on common roads? Let Mr. Gurney's own total abandonment of his own carriages answer; or, if that will not suffice, the withdrawal of his successor, Sir Charles Dance,* from the field, the profitable field, of steam-travelling. Is it because he was the first inventor of steam-locomotives on common roads? Mr. Faraday might perhaps say yes (vide his former evidence); but the Committee ought to have been aware, even without asking, that a Mr. Griffith invented and constructed a steam-carriage at least three years before Mr. Gurney commenced his experiments on the subject, and *professed* to have succeeded as perfectly as his more fortunate successor; so that Griffith, and not Gurney, has the best claim on that score. True, his valuable invention has long ago become mere old iron—but what of that? It is not perhaps too late for *him* to apply to Parliament with a fair prospect of catching a few thousands from the golden shower of " remuneration."

If, again, the sixteen thousand are to be given to make up for the losses incurred in prosecuting an abortive project which *might have been* of public utility, it appears most probable that other parties, and not Mr. Gurney, would have the fairest title to " the spoil." In every possible point of view the proposed grant takes the form of an insult to common sense, unless some very unlooked-for and very remarkable facts have come out on the resumed investigation. We shall see.

Steam-carriages have, from the very first, been the subject of some of the most outrageous and ridiculous puffing that could well be imagined; and, in one feature, this puffing has been rather peculiar. The House of Commons has been pressed into the service. A few rodomontade flourishes from interested speculators, backed by not a few corroborative absurdities from shallow pretenders to scientific knowledge, induced the House, four years ago, to commit itself by publishing a Report, embodying and adopting all the trash emitted by these two very trustworthy classes, to the astonishment of all sober-minded lookers-on; an astonishment which time has only tended to increase. And now even that folly, disgraceful as it was, is to be outdone; unless Mr. Chancellor of the Exchequer should continue to withhold his consent to the grant, which, it is heartily to be hoped he will have the good sense and the firmness to do.

Where now are all our once-flourishing steam-carriage builders? The public hears nothing of them; and horse-drawn stage-coaches are still to be seen on the roads, even between London and Holyhead! Where is Gurney, where Russell, Hancock, Redmund, Dr. Church, Colonel Macerone, Ogle and Summers, Sharp and Roberts, *cum multis aliis*. " And Echo answers, ' Where?' " Messrs.

* Have the Committee bethought themselves, this time, of examining Sir Charles, and hearing from his own mouth the details of the *profits* he reaped from running the carriage (or carriages) between Cheltenham and Gloucester? And if not, why not?

Maudsley and Field are, indeed, doing more wonders with their new steamer than any of their predecessors—according to newspaper paragraphs—but, after all that we have read and seen, newspaper paragraphs are not exactly the very best authority on the subject. By this time we ought to have something a little more convincing.—Yours, &c.

H.

London, August 13, 1835.

[We have not yet had access to the *new* evidence in Mr. Gurney's case, but dare say we shall be able to obtain a copy of it, in time enough to make our readers acquainted with the substance of it before the matter is again agitated in Parliament. Mr. Cayley, the Chairman of the Committee, has, we observe, pledged himself to bring the case anew before the House of Commons in the next Session. Our friend H. might, we think, with great propriety, have excepted from the queries in his concluding paragraph, that most persevering, yet least pretending of all the steam-carriage builders, Mr. Hancock. Echo would not in his case answer "where," if Truth were bye to bear witness that he still keeps the field as resolute as ever, and as likely to reach the goal first as any. The authentic accounts given in our last number of the journeys made to Marlborough by Mr. Hancock's "Erin," and the carriage built by Messrs. Maudsley and Field, show that the latter have no real superiority to boast of. We beg also to refer H. to a letter in another part of our present Number, for an answer to his queries so far as Mr. Ogle is concerned.—Ed. M. M.]

THE LATE STEAM-CARRIAGE JOURNEYS TO MARLBOROUGH.

Sir,—The reports given in your number of to-day of the trips to Marlborough and back, of the steam-carriages of Mr. Hancock and Messrs. Maudsley and Field, are both deficient in one important particular—they do not state the weights propelled by each. Without these data, it is impossible to come to any correct conclusion as to their respective merits.

Your obedient servant,

Quivis.

Paddington, August 15, 1835.

[This is true; the information omitted is quite essential, and ought to be supplied.—Ed. M. M.]

THE AMERICAN "FASTEST VESSEL IN THE WORLD."

Sir,—As the account sent you by "an American," of the steam-boat Lexington, and inserted in your journal of Saturday last, does not explain with sufficient clearness the peculiar mode of construction by which she has been enabled to accomplish a degree of speed, hitherto quite unrivalled, and by many deemed utterly unattainable, your readers may be, perhaps, pleased to receive from another American some further particulars on the subject. I have not myself seen the Lexington, but my information respecting her is from a good source.

Suppose two arcs of a circle, passing from stern to stem, the cord of which is rather longer than the vessel, and that the form of these arcs is preserved by braces in the form of an X; suppose, further, these arcs to be placed vertically, opposed the one to the other, and united at their extremities; also, that close to each brace a screw-bolt ties the two arcs together, pressing on the ends of the braces somewhat let in. Such a frame must obviously be immensely strong to resist perpendicular pressure; and two such frames placed parallel to each other, resting on the floor-timbers, and connected with the beams and ribs, cannot but make an extremely stiff yet light vessel. Such, then, is the Lexington. The object aimed at has been to construct a very light hull, having extraordinary vertical strength, so as to be able to carry *much more than usual power in proportion to size*. It may be said to combine ship-carpentry and house-carpentry, with the principle of the bridge. This mode of construction distributes the stress over the whole fabric. A great vertical force may bear on the arc frames; and if much longitudinal impulse is received, it is at their extremities. Even the boilers and cylinders of the engines are borne by these arc-frames; and the action and reaction of the power is all included within them. The shell of the hull buoys up or carries the machinery without being called on to bear any strain.

It is evident that a boat upon this plan, as broad and as long as Burden's twin-boat, will draw but half as much water, and present no more cross section; and while the resistance will be the same,

minus two sides, she will have the advantage of not parting the water at so much depth, and of avoiding by her shape the retarding force following or occurring at the stern.

An insuperable objection to the twin-boat (as has indeed been already verified), is its liability to strike aground or against another vessel or obstacle, suddenly with *one* of the hulls, when of necessity the whole momentum of the *other* is exerted in an effort to rend itself separate. And two hulls that are each so heavy as to sink if filled, doubles the danger, because the sinking of one upsets the whole. Whatever depresses one more than the other, disturbs, moreover, the steering, while a single hull may heel without diminishing the power of the helm.

I am, Sir,
Your obedient servant,
JAMES BARSTOW.

Limehouse, August 17, 1835.

FIRE-PROOF BUILDINGS.

Sir,—On a former occasion, when making some remarks on the origin of fires, and the phenomena of spontaneous combustion, I had occasion to refer to a pamphlet, containing a series of interesting experiments, proposed and conducted by Lord Stanhope, David Hartley, Esq., and others, under the superintendence of the "Society of Associated Architects" (1792-3). Every new conflagration renders it more and more evident, that some legislative enactment must eventually be adopted to lessen the dreadful destruction of life and property by fire. I would earnestly recommend to the present "Society of British Architects" to institute anew, and upon a large scale, experiments similar to those detailed by Lord Stanhope and Mr. Hartley; they seem called on to do so as scientific conservators of public safety, and could not, at all events, but reap honour and credit to themselves from a task of so much national utility.

It has long since been recommended by various architects, that public buildings should, as far as possible, be constructed with fire-proof materials, and, to a considerable extent, this has been done, though accompanied with a considerable increase of expense. In public works this additional expense is not, perhaps, of much consequence, as it is the means of ensuring great stability and beauty, which in buildings adapted to national purposes are objects above all price. But in the case of private houses, any means of security, to be generally adopted, must be cheap; and hence the entire absence of security by which they are now so commonly distinguished. The pamphlet says, "that as good party-walls are the means of confining a fire to one house, so other practicable, and not expensive means, will confine a fire to one room in a house." The necessity of this must be apparent to every one who has witnessed the sudden spread of fires in unprotected buildings, rendered still more destructive, as they usually are, by the notorious delays, or the more notorious want of the requisite supply of water. The Committee appointed to examine and report upon the Plans, give, as one cause of the rapid spread of fires, the following:—"The free, constant, and uncontrolled passage of air, behind the wainscoat-linings and battenings, in almost all buildings, as usually constructed, and the easy access of fire from story to story through the floors and up the usual wooden-staircases, which accelerates the progress of fires from whatever accident they begin, and is the great means of rendering buildings combustible." The justness of this observation I am able to confirm. A few months ago I was called in to examine some premises in Horse and Groom-court, Holborn, that were suspected to be on fire. In what part was not known; a smell of fire, however, was communicated to the houses, right and left, lath and plaster buildings; and it was stated, that the smell and occasional smoke had been of two days' duration. Inquiries were made at the house previous to my examination, but the poor woman (I believe she obtained her living by ironing) stated, that she had not had any fire during the whole of one day. The room was wainscoated,* and had been in its time fitted-up in a substantial manner. My first attention was directed to the fire-place and flue; and my suspicions were amply confirmed,

* All the property abutting that part of Leather-lane, was formerly an extensive inn, I believe called the Black Bull; part of the old galleries still remain. It was built previous to the great fire of London.

by observing that the wainscoating in front of the chimney-breast was battened out to the extent of at least three inches, and open at the soffit of the fire-place, allowing a free current of air to pass. Upon passing a rod up this vacuity, I found that appearances indicated that the wainscoating had been extensively charred, and, in fact, had been recently in an incipient state of combustion. Application was made by letter to the Fire-office; the reply I have mislaid, but I recollect that it was exceedingly unsatisfactory. In my opinion, however, the duty of seeing to the matter more particularly devolves on the District Surveyor. I am satisfied that until the property, which still continues in the same state, is condemned either by inquest or otherwise, the whole of the surrounding premises (built principally with timber) will continue in imminent danger from accidental fire.

I am still of the opinion, I once avowed, that the majority of fires are not accidental, and that the only way to diminish their number is to construct houses in such manner as will effectually confine the destruction to one house or to one room.

I shall, with your permission, continue this subject in a subsequent number of the Mechanics' Magazine, and give such account of the experiments alluded to above, as may, perhaps, be the means of obtaining for it a greater share of the public attention than it has yet received.

I am, Sir,
Respectfully yours,
C. Davy, Architect.

3, Furnival's-Inn, August 18, 1835.

INTEMPERANCE, NOT DIVISION OF LABOUR, THE BANE OF THE WORKING CLASSES.

(To the Editor of the Mechanics' Magazine.)

Reading thy Magazine, June 13, 1835, under the article "Evil effects of the division of labour," I find thy correspondent, L., attributes the evil actions of the poor mechanic to his early employment being monotonous, and requiring no exertion of mind. In my opinion, it is not the existing system of labour, lowering, as it does, the cost of the necessaries and luxuries of life (as "L." himself admits), and placing them within the reach of a far larger proportion of the community than could otherwise obtain them—of many even of the mechanics themselves,—it is not this system, I say, but intemperance which is the rock on which they split; a rock which I verily believe is reared by the grand adversary of man's happiness, to destroy the morals and produce the misery and crime we have deploringly to witness. It is the temporary excitement of the gin-shop, which is the commencement of the mechanic's ruin; he increases his draught of the deadly poison, till ere many days he becomes a victim to a depraved appetite. The stimulus and pleasure the spirits give are momentary compared with the permanent weakness of the body and debility of mind, which are the inevitable results of an habitual use of even a small quantity of ardent spirits. In saying so, I only repeat the declared opinion of several hundred physicians and surgeons, many of them ranking high in their profession. Let not, then, the mechanic be led to think that the revival of a by-gone system of manufacture would be for his benefit, or that he is in any way more disadvantageously situated than his forefathers. Let him be assured that temperance will give him the means of obtaining lasting comfort and pleasures, which he will seek in vain for at the gin-shop. I believe "L." to be very far wrong in supposing that any feeling of alienation exists among the rich towards the poor. Judging from the many active benevolent institutions which have for their sole aim the moral and religious good of the poor, I should conclude that a contrary feeling of kindness and sympathy prevails in a greater degree than at any former period in the history of our country. In a town near the metropolis (one out of a great many), some benevolent individuals have taken land, and relet it to the poor at very moderate rents; this is the poor man's bank, where is deposited all the spare time and labour of himself and children, and it yields good interest, healthy and innocent employment, and the supply of his simple board with bounteous fare, by which the desire for the deceptive gratifications of intemperance is lessened, if not entirely subdued. A more extended and a better education is much wanted. A part of this education of the young should consist in impressing on the sus-

ceptive mind the pleasures of temperance, and the sin and misery attendant on intemperance. Government has done something in the grant of 20,000*l.*; but, I trust, this is only a prelude to further grants, as an encouragement to the opulent classes to exert themselves,—I would by no means, however, leave the matter of education to the Government. I am so convinced that the labouring classes, when strictly temperate, may be their own helpers, and, consequently, their children's, that I will conclude with the relation of a fact, which is only advanced as an instance to show what all who are similarly situated might do, if willing to adopt the means. A mechanic at Portlaw states, that before he became a temperate man, the habits of himself and family were ruinous,—that there is almost a certainty of a drunkard's children becoming dissolute, being at liberty to do as they please, whilst their parent, who ought to be their guardian, is drinking or getting drunk. He said that he might at one time have removed to Manchester with great advantage, but never had the means of paying the necessary expense whilst a drinker, but since he had become temperate, he had as many pounds in his box as would take him comfortably. A sober mechanic will prevent his children going to the gin-shop, and the money which is so generally spent in drinking he saves, and may appropriate to the education of his offspring.

This replies to a part of the communication from " L.," by inserting which (if thou thinkest well), will oblige a constant reader.

A. B.

Worcester, 8 Mo. 14, 1835.

NOTES AND NOTICES.

The Royal Society Gold Medals for 1837 (two of 50 guineas each, presented by the King), are to be awarded as follows:—One to the author of the best paper to be entitled, " Contributions towards a System of Geological Chronology, founded on an Examination of Fossil Remains and their attendant Phenomena;" and the other to the author of the most important unpublished paper on physics, which may have been communicated to the Royal Society for insertion in their Transactions between the 1st of March, 1835, and June, 1837. The competition is open, by command of his Majesty, to the scientific men of all nations.

The Fourth Annual Meeting of the British Association, held in the Irish capital during the past week, appears to have given great and universal satisfaction. We quote the following from the *Dublin Evening Post*:—" A more imposing, a more triumphant display, was never made in any country, nor were our distinguished guests ever more satisfied with the manner in which they have been received. Almost every member of the body, in public as well as in private, expressed their sense of their cordial and hospitable reception in Ireland. We need not say how entirely delighted we are that such men as Brisbane, Sedgwick, Murchison, Daubeny, Wilkie, Babbage, the renowned travellers, Franklin and Ross, as well as the illustrious foreigners who assisted at the meetings, shall carry away with them so gratifying a recollection of the Green Island. They will see that, however torn the country is by domestic dissensions, there is still sufficient good fellowship amongst us to merge our disputes in temporary oblivion when we have to discharge the duties owing to hospitality and to science."—We shall give a sketch of the proceedings next week.

Fires about London.—Mr. Braidwood, the directing superintendent of all the London co-operating fire-stations, says that never since the first organization of the present plan in January, 1833, has there occurred within the same limited number of days any thing like a parallel to the number of distinct fires that have within the last few days been every where blazing forth. On a careful review made yesterday of the returns obtained from the 12 metropolitan stations and to the head office since the 31st of July, a period of only 20 days, they exhibit an astounding list, after omitting mere fires in chimneys, and such minor accidents, of no less than 108 distinct houses, or warehouses, in London, or its immediate environs, that have been on fire, in the full sense of the word, within this brief period. Of these, no less than 39 were destroyed, 26 greatly damaged, many of these requiring large outlay before they can be made again habitable, and 43 that have been slightly damaged. The value of the property sacrificed must be immense, perhaps a quarter of a million sterling would be a moderate estimate. Besides these, there have been in the same limited period three great agricultural fires near London; one at Mr. Bacon's farm, near Tottenham, where four stacks of hay, and one of beans, were greatly damaged; another at Mr. John Emmett's, in the Kent-road, where two barns, a range of stabling, and four stacks of hay, were destroyed; and, lastly, at Beckley-farm, near Bromley, where 30 corn-stacks, 7 hay-stacks, a house, granary, ranges of cattle-sheds, and extensive stabling, were all consumed by fire, and unhappily under circumstances that lead to the presumption the act was wilful, and had its rise in the party feuds and deep enmity engendered in the breasts of many English labourers, whose harvest hopes have been blighted by the arrival of gangs of Irish labourers. It is the opinion of Mr. Braidwood, the superintendent, that the cause of the late great increase and rapid spread of fires is to be found in the extraordinary dryness of the season. With the exception of a heavy complaint preferred against the New River Company, the firemen make no charge of a deficiency of water. On the contrary, in the district supplied by every other metropolitan company, the supply has been declared abundant; yet as respects the three great fires, in Barbican, in Charterhouse-square, and the Haymarket, each of which districts is supplied by the New River mains, for some time there was no supply, and at no time a good one. In looking back to the great number of late fires, it is amid pity for the very many who must have been reduced to destitution, a great source of joy to find only one human life was destroyed. This is, perhaps, to be attributed to the high state of discipline the firemen have been brought to, to the intrepidity engendered by the assurance of the fire-offices that their appointments are for life, and can neither be cancelled nor lessened by any cause but their own wilful misbehaviour, and to the able co-operation they obtain from the new police.—*Times, Aug.* 21.

Optical Curiosity.—The celebrity of Mr. Roberts of Manchester, of the firm of Sharp, Roberts, and Co., as a machinist is generally known. We understand that when Lord Brougham was in Manchester lately, amongst the curiosities exhibited to his lordship by Mr. Roberts was an optical machine, by which small print may be read when revolving 28,000 times in the minute. The time given for one view is about the eighty-thousandth part of a minute.—*Macclesfield Courier.*

New Steam-Boiler.—There has been lately an improvement in steam-boilers made by Mr. L. Disbrow, and tested in the steam-boat of the Delaware and Hudson Canal Company, by which there is a saving made compared with wood of 45 to 50 per cent. in the expense of fuel. It consists of a number of conical furnaces, the base of which is the grate, the apices being connected by a small flue. These all immersed in the water and half full of coal, make a steady and strong fire. They are fed near the top of the caves by horizontal openings.—*American Paper.*

Railways in America.—The stock of the Baltimore and Ohio Railroad, which while that work was unfinished had fallen to one-third of its nominal value, has now that the road is done, risen suddenly to par; and the stock of every finished railroad in the United States is also above par.—*Winchester Republican.*

The Bell Rock Light-House has suffered greater damage during the severe gales of the last autumn and winter than at any time since its erection. The spring-tides in January rose to 116 feet, and drifted over the building; while, on ordinary tides, 19 feet is the extent of their rise. The heaviest ground-swell preceded the heaviest wind by two days. Some large rocks, called "travellers," were thrown up against the foundation of the light-house, weighing about 5 tons!

Francis Moore is, as our readers are aware, rather a favourite of ours, and for one reason, amongst others, that his prophecies, however objectionable on the score of pretence, are invariably on the side of liberty and justice, and therefore calculated to do good. Of this we have, in his Almanac for the present year, a most remarkable illustration. At the end of July, and beginning of August, there is to be seen, in a *fine Roman hand*, this ever-memorable warning:—"Ah! Philippe, beware! see to it, that your throne rests on the affections of the people!" If Philippe had only had as much reverence as we have for the sayings of Old Francis, how easily might he have avoided the imminent danger to which his life has been recently exposed! As Moore's Almanac, by-the-bye, is largely circulated in France—being republished there immediately after its appearance in England, and nearly as great a favourite with the French as with the English commonalty—how do Philippe and his Ministers propose to reach it by their new laws against the Press? We see nothing in them to prevent our friend Francis from warning and prophesying as usual; and to leave *him* ungagged is to do nothing. We recommend this new difficulty to their serious attention.

Liverpool and Manchester Railway—Seventh Half-Yearly Meeting.—The Directors reported a continued increase in the traffic, as compared with the corresponding six months of last year. The receipts of the half year ending 30th of June, amounted to 99,474*l.* 16*s.* 6*d.*, and the expenses to 61,814*l.* 6*s.* 1*d.*, leaving a net profit for six months of 37,660*l.* 9*s.* 10*d.* A dividend of 4*l.* 10*s.* per share (for the half year) was resolved upon. The shares are now quoted at 200*l.*

The London and Birmingham Railway shares, on which 50*l.* has been paid, are now selling for 60*l.* 5*s.*

The Bristol and Gloucestershire Railway (from Bristol to the great Westerleigh coal-field) was opened on the 6th inst. It is 9 miles long; and the cuttings and embankments are supposed to be greater than on any railway of similar extent which has yet been formed. There is a tunnel (under Staple Hill) 1,540 feet long, 12 wide, and 16½ feet high; it is in a straight line, 3 shafts by which the excavations were carried on being left open to admit light. One of the embankments is 56 feet in height. The capital expended on the undertaking is about 77,000*l.* The Act was obtained in June, 1828, and the works were commenced in June, 1829. Mr. Townsend is the engineer.

Steam-Engines in France.—From an account of steam-engines in France, made up under the direction of the Administration des Mines to the end of 1833, it appears that there were 947 steam-engines, possessing together a force of 14,746 horse-power—a single horse-power being estimated at 75 kilogrammes, or 165lbs. avoirdupois, raised to the height of a metre, or nearly 4 feet in a second. Of these engines, 759 were made in France, and 144 abroad; the place of manufacture of the remaining 46 not being ascertained. The year 1833 was that in which the greatest number of engines had been erected. These amounted to 130, of which 5 only were of foreign manufacture. Of the 903 engines whose place of manufacture had been ascertained, 334 were of low-pressure, and 569 of high-pressure. On the 1st of January, 1834, there were in France 95 steam-vessels, besides those in the service of the Government. The engines they employ are 118 in number, of which 32 are low-pressure, and 36 high-pressure. These vessels have been built when the low-pressure was most in favour. Of these 118 engines, which presents a force of 3,480 horse-power, 34 are of French construction, 59 foreign, and 35 unknown.

The Railroad from Brussels to Malines cost 1,224,100 francs, and produces immense profit to the Belgian Government, which established it. The receipts from the 17th of May to the 31st of July last, were 106,802 francs, paid by 163,482 passengers. The distance is 4 leagues, and the journey is made in 35 minutes.—*Paris Advertiser.*

Negro Longevity.—A female negro slave, of the name of Joyce Heth, is now exhibiting in this city, who has attained the extraordinary age of 161 years. A visit which we paid her yesterday has removed whatever doubts we previously entertained as to the facts confirmatory of this extraordinary instance of longevity.—*Pittsburgh (U. S.) Advertiser.*

India-Rubber Manufacturing Companies seem now all the rage in the United States. In the state of Massachusetts alone there are already six, with capitals of from 10,000 to 100,000 dollars.

We have received Colonel Macerone's reply to Mr. Ogle, but it requires an engraving to illustrate it, which cannot be got ready before next week.

Communications received from G. B.—Vindex—A. R.—D. C.—Mr. Akers—R. B. A.—Mr. Wallace.

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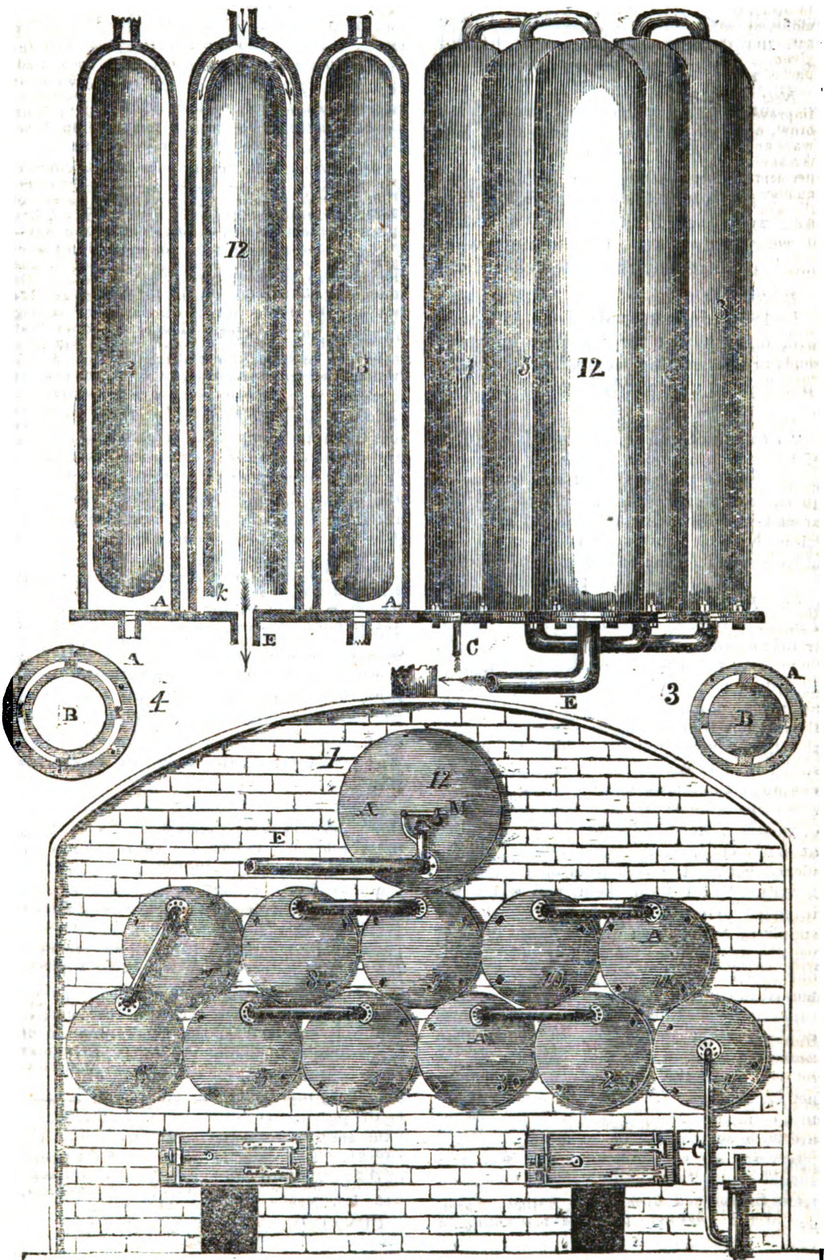
M'CURDY'S DUPLEX GENERATOR.



M'CURDY'S DUPLEX GENERATOR.

Sir,—I perceive that Captain Ogle accuses Colonel Macerone of having stolen from him his double-tubed boiler; and we shall have Colonel Macerone, I dare say, maintaining, ere long, that he did nothing of the kind, but was himself the original and true inventor. Now, sir, without meaning to accuse either of these gentlemen of petty-patent-larceny, I beg to be permitted to show that the merit of the invention belongs to neither, and that they have both equally fallen into the grave (though not unusual) mistake, of re-inventing and re-patenting what had been invented and patented several years before.

In 1826 (June 21), Mr. John M'Curdy took out a patent for "certain improvements in generating steam," which in the specification afterwards enrolled are thus described :—

"I construct one or more vessels or tubes of any given number, length, or diameter, proportionate to the size of the engine, or quantity of steam wanted, made of wrought or cast-iron, or other material of sufficient strength; which tubes or vessels are closed at both ends; on one end of each of which a head is fixed, that can be taken off at pleasure. *Inside of each of these vessels or tubes, I insert or suspend in the centre another vessel or tube of still smaller size of similar materials,* leaving a small space on all sides, varying, according to their size, from one quarter of an inch to one inch and a half (according to the station they occupy in the furnace near the fire or more remote), which is thought sufficient for the generators attached to an engine of the largest size: *between the outer and inner tubes or vessels.* The inner tubes or vessels are rendered steam-tight, and closed at both ends, except such number as are placed within the reservoirs or "STEAMOMETERS," as I term them, and which are intended to contain a body of steam for the supply of the engine: or the minor tubes or vessels may be omitted entirely in this combination in the steamometers, or vessels intended to contain the steam. I place these tubes or vessels thus arranged, which I term duplex steam generators, in a common heated furnace, in the same manner as gas retorts, or in the most advantageous manner for heating. The tubes or vessels at the top, or next communicating with the engine, are the most suitable to be reserved for the reservoirs or steamometers, and which I should generally make to contain about ten times the solid contents of the working cylinder of the engine. The outer or exterior vessels or tubes are connected by pipes leading from one to the other, which connecting pipe ought to lead from the upper part of another, through which the steam and water rushes, from the time it is injected by the forcing pump, which I use to supply them with water till it passes into the steamometer, and from thence through the eduction pipe, which I insert into the *lower part or bottom* of the steamometer (whereas in boilers the steam is carried out at the top) into the engine. Into each of the interior tubes or vessels (closed at both ends) may be inserted small pipes, passing from the inner tubes or vessels through the outer ones into the open air, to permit any water or steam, that might be forced into the inner vessels or tubes by the pressure of the steam, to escape. To keep the interior tubes or vessels in their places, and at equal distance from the outer ones, I put around them spiral bands, extending the whole length of the inner tubes or vessels, or rings at intervals, of from one to two feet apart, or pins of the same thickness as the space intended to be preserved as a water line; these rings are grooved all round, or have holes drilled in them to permit the free passage of the steam and water; and if the heat should cause the outer tubes or vessels to warp or yield, the same distance will always be preserved between the outer and inner tubes and vessels, and also prevents them from coming in contact in any part."

The patentee then refers to certain drawings annexed to the specification, in which a boiler of his construction is represented. I send you copies of these drawings, to be engraved and published as an accompaniment to this communication, if you should think the justice of the case requires it (in which case I am sure you will not grudge the expense). The following is the inventor's description :—

"A A A, &c. represents twelve wrought-iron external tubes or vessels set in a furnace; these tubes or vessels are 12 feet long, 12 inches in diameter, and an inch thick, except the upper one, which is intended as the steamometer, which is 18 inches in diameter. B B B represents two of the interior tubes made of similar materials closed at each end, the middle one or steamometer, No. 12, being opened at the end at which the steam passes into the engine, and closed at the end at which it enters from the generators. This large tube, or steamometer, No. 12, is intended to contain steam for the supply of the engine. C represents the water-pipe leading to the pump. D is the pump. E, the steam-pipe leading from the steamometer into the engine. The water is introduced by a stroke of the pump into the external tube or vessel, No. 1 (by the pipe C), through which it passes, or is forced and distributed around the space, between A and B, which is represented by a white line, and may be termed

the water-line, in all the tubes or vessels; the force of the steam generated in this vessel or tube, drives the steam, and such part of the water as remains, through the connecting-pipe into the second vessel or tube, No. 2, and from thence through Nos. 3, 4, 5, and so on to No. 12, striking against the closed end of the interior tube or vessel in No. 12 (as shown by the direction of the arrow), the opposite end of this tube or vessel is left open, as shown by *k*, out of which the steam passes into the engine through the pipe E. The water injected by the pump at C has thus, in its passage from the pump to the engine, to produce steam, passed (spread in a thin sheet) over a heated surface, a space equal to about 65,000 superficial inches; in fact, from the peculiar construction of the duplex generators, the steam and water has passed between two heated surfaces, each of which contains about that extent, making nearly 130 000 inches, the steam is consequently generated with astonishing rapidity, and collects in the steamometer, No. 12, opened at one end and marked *k*. M represents the safety-valve; the end-view represents a set of five generators and steamometer.

"In consequence of the small space between the outer and inner tubes or vessels being always preserved, there can be no accumulation of water, the rush or current being constant along the water-line; nor would the diameter of the generators cause any difference in this respect, the water-line being so minute and uniform. The generation of the steam is rapid and instantaneous, and no greater quantity of water (or very little more) will be contained in a set of the duplex generators, however numerous, at any one time, than is injected at a single stroke of the pump; the quantity of water injected into the duplex generators may be regulated by a stop-cock, placed on the pipe leading to the cistern, or place from whence the supply of water is obtained: this water is kept in a boiling state by the discharge of the steam from the engine into the cistern or tank. The pipe leading from the steamometer to the engine should be inserted on a level with the bottom of it, so that if a small quantity of water should ever reach the steamometer without being turned into steam, it would pass or be forced through the engine with the steam. A cock may also be inserted into the lower part of the steamometer, to test the fact, whether the pump threw too much water into the generators.

"The twelve duplex generators in the drawing expose to the action of the heat a superficial surface of about 65,000 square inches, which is nearly equal to the surface of a boiler 8 feet in diameter, and 20 feet in length, provided the whole boiler was buried in the fire; but as the fire is only applied to about one-third of it, the generators in the drawing (which occupy a space of 12 feet in length, 5 feet in height, and 6 feet in breadth) expose a surface to the action of the heat three times as great as a boiler of the above dimensions, every part of which surface is constantly exerted in generating steam. The weight of such a boiler and water would be 43 tons, the generators about 4½ tons."

By comparing the preceding descriptions and the drawings (should you insert the latter) with the boilers of Colonel Macerone and Captain Ogle, the reader will at once perceive that they are both on identically the same principle as Mr. M'Curdy's.—Yours, &c.

N. D. C.

MR. GALT'S SUBSTITUTE FOR STEAM POWER.

The following is an extract of a letter addressed by Mr. Galt, the celebrated novelist, to the *Greenock Advertiser* :—

"The fatal explosion of the Earl Grey steamer has induced me to try if the principle of my pressure-syphon could be applied to propel vessels; and the result has been so perfectly satisfactory, that I find myself actuated by humanity to make it public, that others may test the experiment, the simplicity of which is not the least of its merits.

"Take a cylinder, and subjoin to the bottom of it, in communication, a pipe—fill the pipe and the cylinder with water—in the cylinder place a piston, as in that of the steam-engine—and then with a Bramah's press, and a simple, obvious contrivance, which the process will suggest, force the water up the pipe, the pressure of which will raise the piston. This is the demonstration of the first motion.

"Second—when the piston is raised, open a cock to discharge the water and the piston will descend. This is the demonstration of the second motion, and is as complete as the motion of the piston in the cylinder of the steam-engine; and a power as effectual as steam is obtained without risk of explosion, without the cost of fuel, capable of being applied to any purpose in which steam is used, and to an immeasurable extent.

"The preservation of the water may in some cases be useful, and this may be done by a simple contrivance, viz. by making the cock discharge into a conductor, by which the water may be conveyed back at every stroke of the piston to the pipe, at the end of which the Bramah's press acts.

"My condition does not allow me to do more than to solicit that the experiment may be tested. Although no mechanic, I yet believe myself mechanician enough to see the application of the principle."

STEAM-VESSELS IN GREAT BRITAIN.

Sir,—I send you an abstract of a return lately made to Parliament, showing the number of steam-vessels, and the amount of their registered tonnage, in the different ports of Great Britain, which, I conceive, will prove interesting to many of your scientific readers.

I am, &c.

J. K.

London, August 21, 1835.

PORTS.	No. of Vessels.	Registered Tonnage.	PORTS.	No. of Vessels.	Registered Tonnage.	PORTS.	No. of Vessels.	Registered Tonnage.
London	98	11,785	Liverpool	28	3,095	SCOTLAND.		
Beamaris	1	74	Newcastle	82	1,642			
Bideford	1	109	Newport	1	58	Aberdeen	7	1,409
Bristol	14	1,591	Plymouth	3	379	Alloa	4	292
Cardiff	1	75	Portsmouth	3	100	Campbleton	2	182
Carlisle	2	412	Ramsgate	4	723	Dundee	4	893
Chepstow	3	125	St. Ives	1	127	Glasgow	56	5,298
Colchester	1	29	Southampton	8	576	Inverness	1	18
Cowes	3	203	Stockton	7	313	Kirkaldy	3	286
Dovor	6	350	Sunderland	14	311	Leith	4	1,014
Gloucester	1	38	Swansea	4	166	Port Glasgow	2	143
Goole	3	292	Whitehaven	4	483	Stranraer	1	95
Hull	15	1,901	Yarmouth	1	21			
Ipswich	2	122				Scotland—Total	84	9,630
Lancaster	2	134	England—Total	313	27,219			

No. of steam-vessels registered in Great Britain ....397, tonnage 36,849.
Ditto ditto belonging to Great Britain, not registered.. 84 } tonnage unknown.
Ditto ditto building in Great Britain .... 46 }

There are 6	steam-vessels	under	10 tons.
68	ditto	from	10 to 20 tons.
79	ditto	——	20 to 50 ditto.
118	ditto	——	50 to 100 ditto.
41	ditto	——	100 to 150 ditto.
34	ditto	——	150 to 200 ditto.
34	ditto	——	200 to 300 ditto.
16	ditto	——	300 to 400 ditto.
1	ditto	above	400
397	steam-vessels—average tonnage 92·8.		

The six largest vessels are, the

Monarch of London......	587 tons.	City of Aberdeen	384 tons.
Dundee of Dundee	399 do.	City of Hamburgh......	380 do.
Perth of Dundee	399 do.	John Bull, London......	398 do.

Of the eighty-two steam-vessels belonging to Newcastle, one only exceeds thirty register tons.

The registered tonnage is only about one-third of the tonnage by admeasurement; we may therefore estimate the aggregate tonnage of the steam-vessels in Great Britain above 100,000 tons.

Some curious results would be obtained if we could learn the amount of horse-power employed in steam-navigation, the amount of fuel consumed, and the average speed per hour these vessels proceed at.

MR. OGLE'S STEAM-CARRIAGE BOILER—REPLY OF COLONEL MACERONE TO MR. OGLE.

Sir,—In reply to Mr. Ogle's courteous and polished communication in your 626th Number, be it known that, in March, 1832, I *did*, in conjunction with

Mr. Squire, construct, or rather begin the construction of a steam-generator, consisting of an aggregation of *double concentric* cylinders, in perfect ignorance of any thing similar having been previously made or patented. This was nine months *before* Mr. Ogle's arrival with his carriage in London from Liverpool, and not "some time after" the said advent, which occurred in the following December. We placed the boiler on a rough frame and wheels by way of trial; and with the aid of certain important additions to it (which Mr. Ogle has not got), it performed very well, although without a blower or artificial draught. For several weeks we made short experimental runs round Paddington-green and in the neighbourhood, during which (in August, I think) Mr. Squire nearly demolished a house on Paddington-green. In the midst of these our operations, Colonel Viney (now General Sir James Viney) came to me, and showed that I was infringing upon *his* patent of 1829. Shortly afterwards Mr. Alexander Gordon, also, assured me that I was infringing on Mr. Ogle's patent. And it was either Colonel Viney, or Mr. Gordon, who brought me the two Numbers of Newton's *Journal of Patent Inventions* for November 1, 1831, and March 1, 1832, containing the two specifications on which they founded their assertions. I found that they were both in the right; so we pitched the poor boiler into the old iron heap, and set about making a new one of simple cylinders, having first examined every specification I could find to avoid being tacked again to a "wife of many husbands."* It was not till the following month of July, 1833, that I was enabled to complete the funds for the sealing of this patent, when we forthwith commenced running publicly to Edgware, Harrow, Watford, Windsor, &c., with the carriage and boiler represented in your Magazine; the independent, editorial, and other reports of which journeys by Mr. A. Gordon, Robert Wallace, M.P., Leitch Ritchie, &c., Mr. Ogle is pleased to call Macerone's "bombast and puffing!!" This was the boiler, alongside of which Mr. Ogle was obliged to push his great horse to a gallop on our way to Windsor, September 8, 1833. This is the boiler that has been in use ever since, either in this country, in Belgium, or in France, and which is now as good as new.

Now the point is, which is the boiler which Mr. Ogle patented in 1830, and which he has had on his carriage or carriages ever since? The specification says—"They claim (Summers and Ogle) as their invention the placing of an inner flue or tube for the escape of the heated air or gas arising from the fire, inside a larger tube or vessel in a perpendicular position; the said inner flues running through the inside of the larger tube or vessel, and out at the top, the larger vessel being also in a perpendicular position. The water is contained in the space between the two concentric vessels." Here is a drawing and description of this taken from Alderson's "Essay on the Steam-Engine." Similar descriptions may be seen at the Enrolment-office, in Mr. A. Gordon's, and other works on steam-power; and it corresponds with that which I, and every body else who chose to look, saw on the carriage with which Mr. Ogle arrived in London in 1832, as well as on a smaller one which he fitted up at the Horse Bazaar, Baker-street.

Mr. Alderson's Description.

"Messrs. Ogle and Summers constructed a steam-carriage to run on the common roads, and had a patent for the boiler which they used. Annexed is a plate of the same. The hollow tubes, a plan and section of one of which is given at figs. 1 and 2, are all double, the flame ascending through the inner one and around the outer one, whilst the water is contained in the space between the two; the ends *a* and *b* being the top and bottom of this small boiler. Turn now to the general plan and elevation, and observe that a great number of these tubes are brought together to form the boiler; in this case 48; and they are stated to be equal to four horses' power. Openings are formed at the top and bottom of these tubes so as to connect them; the one series of openings for the water, the other for the steam. With this arrangement, the water in each separate tube is exposed to a double fire, and an immense surface is kept continually heated."

* Viney, Ogle, Church, Trevethick, and Maudsley. The boiler patented by Dr. Church in 1831, and which he showed me at his factory near Birmingham last year, is formed of double concentric cylinders, just like Mr. Ogle's. He has thrown that boiler aside, and now uses one precisely similar to Stephenson's railroad boiler set up on end. Mr. Maudsley's, on the other hand, is Viney's, laid horizontally, instead of being upright. A strange idea that!

ELEVATION.

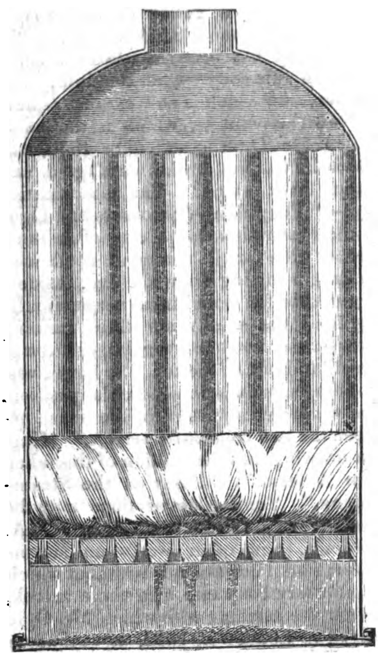
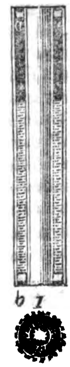
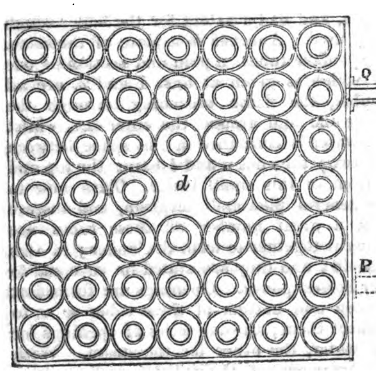


Fig. 2.



PLAN.



Such is the boiler with which, in 1832, Mr. Ogle steamed his carriage from Southampton to Liverpool in eleven weeks, and from Liverpool to London in sixteen or seventeen days; and has since performed many other steam-feats of equal brilliancy.*

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* It appears, however, that Mr. Ogle has made great advances in the art of elementary locomotion during the last two years. The Editor of the *Maidstone Gazette* of April 24 or 26, 1835, gives an animated and admiring account of his journey with Mr. Ogle from Tonbridge to Farnborough, at the rates of *twenty*, *thirty*, and SIXTY *miles* the *hour;* so that the sixteen-mile journey was actually performed in three hours!!!

"TONBRIDGE.—On Thursday morning last we accompanied Mr. Ogle, in his steam-coach, which took its departure from this place, amid the acclamations of a multitude of spectators, who had assembled to witness this great triumph of scientific enterprise. The coach started at the rate of about ten miles an hour, but in descending the first hill, about half a mile from the town, it proceeded something like thirty miles an hour. The first hill it had to surmount was a mile and a half from the town, which it ascended as fast as a man could run. River-hill was a difficulty of far greater magnitude, and which called forth the whole power of the engine, as well as the utmost skill of its talented and enterprising proprietor. The hill, as is known to most travellers, is nearly a mile in length, and extremely steep; Mr. Ogle, however, arrived at the summit *in exactly an hour*, and was received with hearty congratulations by an immense number, who had assembled to witness this great trial of strength. We now travelled in most gallant style, varying from twenty to thirty miles an hour, and we timed the *three miles* from Sevenoaks to Dunton Green, which were accomplished precisely in *three minutes!* Merantscourt-hill, however, now presented itself; its length is a mile and a half, and its steepness is even greater than its predecessor. We were, however, delighted to find that the prediction of Mr. Ogle, that the vehicle would increase its power when the machinery became warm, was completely verified; and this hill, though steeper and half a mile longer than River-hill, was ascend-

This is the boiler which Mr. Ogle, as he was riding alongside our carriage on its way to Windsor, Sept. 8, 1833, accused me of having copied; to which accusation you, Mr. Editor, gave currency in No. 545 of your Magazine. This is the boiler; but it is a waste of words to dwell upon a thing so well known and palpable.

Mr. Ogle is so good as to inform us, that in 1832 he "had constructed *for a particular experiment*" a boiler similar to the drawing he gives you, composed of simple cylinders. It is impossible for me, or any one else, to deny such an assertion! Any man, woman, or child, upon seeing any invention whatever, may exclaim, that fifty years ago (if they be old enough) they had *thought* of it, or constructed it, or privately tried it! Mr. Ogle may safely declare, that twenty years ago he "constructed for a particular experiment" one of Babbage's calculating-machines, or Morgan's paddle-wheel, or any thing else! Who is to prove that he did not? The question is, What is Mr. Ogle's patent? And is it not the thing which he has patented, as above specified, which he has accused me of pirating? That Mr. Ogle has constructed a boiler on the principle of mine, I readily believe; but that was *last January*, 1835, and accomplished with the assistance of one of my quondam workmen, named Kirby. This will be looked into by-and-bye.

I have exhibited the above case and facts, not in any spirit of rivalry or envy, (what of Mr. Ogle's have I to envy?) but in the same spirit of self-vindication which dictated the remarks in my pamphlet, lately published by Effingham Wilson; and I will leave to those who have read it to say, whether I therein "abuse, in contemptuous *language*, the efforts of others who have entered the same arena." Am I to suffer a palpably false, and therefore impudent, accusation, to go unanswered? I have expressed my scorn and contempt for detractors without calling names, and talking of "Bombastes," "jackdaws," &c., like Mr. Ogle. Apropos of "Bombastes," what say you to the sixty miles an hour! the bet of "a thousand guineas," &c., in the *Maidstone Gazette?* All this is in excellent taste, and in good keeping with all that has proceeded from the same quarter. However, particular circumstances compel me to await another opportunity for making my due acknowledgments for the civility shown me.

I have the honour to be, Sir,

Your obedient, humble servant,

V. MACERONE.

August 18, 1835.

P. S.—I have constructed with my own hands a model of a boiler, of far superior attributes than any other yet known. I should be glad to dispose of an interest in it, to enable me to secure it according to our extortional patent laws.

ABSTRACT OF THE PROCEEDINGS

OF THE

Fifth Annual Meeting

OF THE

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE,*

Held at Dublin, August 10-15, 1835.

General Meetings — Rotunda.

Monday, August 10.

General Sir Thomas Brisbane, President for the past year, on taking the Chair, addressed the Meeting in the following terms:—"My Lords, Ladies, and Gentlemen,—We are now assembled in the capital of Ireland for the purpose of holding the fifth Anniversary Meeting of the British Association for the advancement of Science. We all must admire the excellent arrangements which have been made for our reception, and the unbounded liberality by which they are characterised. When you did me the honour to elect me to the distinguished office of president, I accepted it with diffidence; I have used my best, though humble exertions to fill the situation with propriety, and I shall resign it with much satisfaction into the far abler hands of

ed in *twenty-eight minutes.* Our course now was no more obstructed by any hill of importance, and we travelled in most delightful manner until we arrived in Farnborough—*the sixteen miles having been performed in three hours.* Mr. Ogle has thus established the practicability of steam-coaches travelling even the most hilly countries; but much remains to be done; there is evidently great difficulty in regulating the power of the engine, both in propelling it up hill, and restraining its undue velocity in descending. We are very shortly to have another visit from Mr. Ogle, with a coach of much greater power than the present, and with which he has offered to run up River-hill against any horse, for one thousand guineas."—*Maidstone Gazette, April 26,* 1835; *and Weekly Police Gazette, May 2.*

* Compiled from the Reports given in the *Athenæum. Literary Gazette, Saunders' News Letter,* and the *Dublin Evening Post.*

your highly-gifted and enlightened countryman, the Rev. Dr. Lloyd, of Trinity College. Although I expressed my diffidence in accepting the high office of president, you are not to infer that I was indifferent to the distinguished honour bestowed on me in that appointment. On the contrary, I look upon it as the highest I ever enjoyed. The celebrated Dutch geometrician, Van Ceulan, who devoted the greater part of his life to the task of ascertaining the exact proportion between the diameter of a circle and its circumference, and in order to arrive at the utmost degree of accuracy, carried it to one hundred places of figures, directed at his death that these figures should be engraved on his tomb-stone. In imitation of Van Ceulan, it shall be my desire that the circumstance of my having been President of the British Association be recorded on my grave as the most exalted tribute to my memory. I need not infringe on your valuable time by dwelling on the wide field for scientific inquiry which Ireland presents, or enumerating the many illustrious individuals to whom she has given birth. They are familiar to us all. Neither need I tell you that her literature has a venerable claim to antiquity. All Europe acknowledges the talents of a Burke, a Sheridan, a Swift, a Goldsmith, a Kirwan, an Usher, and many others, who are gone to their rest. In our days we look up to this bright constellation, by some of whom we are surrounded—a Brinkley, a Robinson, a Hamilton; and, though last not least of her illustrious sons, the immortal hero of Waterloo. No man who has resided in Ireland, as I have done for nearly four years, can have left that country but with a deep impression, arising from the uniform kindness, hospitality, and friendship, which every stranger receives from her warm-hearted sons; and it is with the utmost sincerity I assure you, that the days I have passed in Ireland have been among the happiest of my life. Few individuals have had more extensive opportunities of witnessing the gallantry, good conduct, and cheerful subordination of the Irish soldier, under all the various and trying circumstances incident to the service; and I can bear ample testimony to the fact, that no men have deserved better of their country. I fear you will consider me as having travelled out of my *record* in touching upon military matters; but the partiality which I entertain for my profession must plead my apology. We have much to regret the absence of many of our enlightened members. At the head of the list I should place the Bishop of Cloyne,* and, what embitters the consideration of his absence, is the reflection that it arises from illness. As I perceive we have been attacked in some of the periodical journals for making too long speeches at our meetings,—if I should address you at greater length, I fear I may render myself liable to become the subject of their sarcasm. I shall, therefore, conclude by moving, that the Rev. Dr. Lloyd, who is eminently known to you all, shall take the Chair as president."

Dr. Lloyd (Provost of Trinity College) was then conducted to the Chair, amidst general acclamation, and proceeded to open the business of this year's meeting by a very judicious and eloquent address, on the beneficial influence of the Association on the progress of knowledge. He dwelt particularly on the powerful impulse which it had given to the new science of geology, and adverting to the outcry which had been raised in certain quarters against the geologists, for the supposed opposition of their theories to the Mosaic history, observed:—"It may not be generally known, because it can scarcely be believed, that without these walls there are to be found individuals, though I hope not many, who regard your exertions with something like painful apprehension; finding themselves unable to reconcile the discoveries which have been made in a certain department of science, to which your attention is here invited, to their views of the Mosaic history. With these apprehensions it would be my wish to deal tenderly, if I could but learn how to respect them. I mean not to insinuate that such persons could propose to restrict the investigation of truth, in any of the avenues which may be supposed to lead to its possession; or that they could possibly think that we should suppress any of the discoveries which have been made, however alarming in their view of them; for this would be (to use the language of Bacon) *Deo per mendacium gratificari*. But I do mean to assert, and I do assert it most confidently, that they are themselves to blame for that indigestion of which they complain. Happily, however, as their aliment has its source altogether within themselves, so also is the remedy within their own power; and if they would permit me to advise, I think I could help them with a prescription suited to their case. I would recommend that they should proceed with more patient circumspection, or, at least, more of self-distrust and doubting humility, both in their interpretation of the language of the sacred historian, and in the inferences which they venture to draw from certain discoveries which have been made in geological science." The "case between Moses and the men of science," stood simply thus:—"From Moses it is collected by the most learned chronologers, that the human race has existed about seven thousand years. According to geologists, the race of man is coeval with the

* Dr. Brinkley.

earth in its *present* form, but they see reason to believe, that the globe, though in some different condition, is far more ancient than the races by which it is now inhabited, and the indications discoverable in the sacred records, as far as they help to decide, are, as we perceive, in favour of this notion of its higher antiquity." Some admirable observations followed on the disposition of mind, with which men should apply themselves to the study of the wonders of creation. "What I insist on is this—that when we seek God through the indications of his power or his will, contained in his word or in his works, we should apply ourselves to the task with patient self-distrust and humble reverence, amounting to religious awe. This is the frame of mind which becomes us when we would approach the Father of Lights; and I would add, that this is the frame of mind which every advance in the study of his works, no less than of his word, is fitted to produce. In fact, it is only the grossly ignorant who is insensible to his own ignorance. The more extensive our knowledge, the greater the number and variety of the subjects which present themselves for further inquiry. The wider the sphere of illumination, the more expanded is the surface which separates it from the regions of darkness; and the greater the extent of our intellectual domain, the more numerous the points in that boundary by which we are sensibly confined. This growing sense of our insufficiency, adequately to comprehend the workings of Divine power, serves but to increase the wonder excited by what is already brought within the compass of our discernment; and whilst man is humbled, God is exalted. Can we then fail to acknowledge, with the illustrious Bacon, the religious uses of natural science, when, in that glowing language so peculiar to himself, he thus expresses his convictions: — *Philosophia naturalis, post verbum Dei, certissima superstitionis medicina est; eademque probatissimum Fidei alimentum. Itaque, merito religioni donatur tanquam fidissima ancilla, cum altera voluntatem Dei, altera potestatem manifestat.* Perhaps nothing can be more just than this representation of the benefits to religion to be derived from the study of nature; yet I confess that I have been still more deeply impressed with the intimate connexion between them by an incident which occurred to a young gentleman of fashion, who, with myself, some thirty years ago, happened to join a party on a visit to the splendid gardens of the Dublin Society. On that occasion a remark was made by one of the company relative to the frailty of the objects which engaged our attention, and which was mistaken by him for disparagement. I was glad of the mistake, as it drew from him an expression which brought the truth I have just been inculcating home to my mind with so much power, that I can never forget it. He replied, that he was affected by what he saw in a manner widely different; for that to him "it seemed that the earth we inhabit, with all its magnificent furniture, no less wonderful in its structure than splendid in its appearance, must have been made, *not for men, but for gods.*"

Professor Hamilton (Astronomer Royal of Ireland, and one of the Secretaries of the Association for the present year,) next rose, and read an Address suitable to the occasion. After a most animated exordium on the agency of the social spirit in stimulating men to intellectual exertion, the learned Professor proceeded to speak of the "essential and characteristic circumstances" by which the British Association "differs from all others, and of the peculiar means which it possesses of awakening and directing that social spirit to scientific purposes." First, it differed in its magnitude and universality from all lesser and more local societies. What other societies do upon a small scale, this does upon a large; what others do for London, or Edinburgh, or Dublin, this does for the whole triple realm of England, Scotland, and Ireland; its gigantic arms stretch even to America and India, insomuch that it is commensurate with the magnitude and the majesty of the British empire, on which the sun never sets. But it was not merely in its magnitude and universality, and consequently higher power of stimulating intellect through sympathy, that this Association differed from others. It differed, also, from them in its constitution and details; in the migratory character of its meetings, which visit, for a week each year, place after place in succession, so as to indulge and stimulate all, without wearying or burdening any; in encouraging oral discussion, throughout its several separate sections, as the principal medium of making known among its members the opinions, views, and discoveries of each other; in calling upon eminent men to prepare reports upon the existing state of knowledge in the principal departments of science; and in publishing only abstracts or notices of all those other contributions which it has not as a body called for; in short, in attempting to induce men of science to work more together than they do elsewhere, to establish a system of more strict co-operation between the labourers in one common field, and thus to effect more fully than other societies can do, the combination of intellectual exertions. Admitting freely the claims of the older societies and academies of the empire to our gratitude for their services to science, and acknowledging that there is much work to be done which can only be done by them, the

worthy Professor thought that we must still turn to this Association, as the body which is *co-operative* by eminence. The *discussions* in its sections are more animated, comprehensive, and instructive, and make minds, which before were strangers, more intimately acquainted with each other than can be supposed to be the case in any less general body: the *general meetings* bring together the cultivators of all different departments of science; and even the less formal *conversations*, which take place in its halls of assembly during every pause of business, are themselves the working together of mind with mind, and not only excite, but *are* co-operation. Express requests also are systematically made to individuals and bodies of men, to co-operate in the execution of particular tasks in science, and these requests have often been complied with. But more, perhaps, than all the rest, the reports which it has called forth on the existing state of the several branches of knowledge, were astonishing examples of industry and zeal exerted in the spirit and for the purpose of co-operation. They comprise a very extensive and perfect view of the existing state of science in most of its great departments: and if, in any case, they do not quite bring down the history of science to this day (as certainly they go near to do), they furnish some of the best and most authentic materials to the future writer of such history. But we should not only underrate the value of those reports, but even quite mistake the character of that value, if we were to refer it at all to its connexion with distant researches, and some unborn generation. They would, indeed, assist the future historian of science; but it was not solely, nor even chiefly, for that purpose they were designed, nor is it solely or chiefly that purpose which they will answer. They belong to our own age; they are the property of ourselves as well as of our children. To stimulate the living, not less than to leave a record to the unborn, was hoped for, and would be attained, through those novel and important productions. In holding up to us a view of t e existing state of science, and of all that l.as been done already, they show us that much is still to be done, and they rouse our zeal to do it. Could any person look unmoved on the tablet which they present of the brilliant discoveries of this century, in any one of the regions of science? Could he see how much has been achieved, what large and orderly structures have been in part already built up, and are still in process of building, without feeling himself excited to give his own aid also in the work, and to be enrolled among the architects, or at least among the workmen? Or, could any one have his attention guided to the many wants that remain; could he look on the gaps which are still unfilled even in the most rich and costly of those edifices (like the unfinished window that we read of, in the palace of Eastern story), without longing to see those wants supplied, that palace raised to a still more complete perfection—without burning to draw forth all his own old treasures of thought, and to elaborate them all into one new and precious offering? The Professor then noticed in succession the recently published Reports that were presented to the Association at the last annual meeting. Professor Rogers's, of Philadelphia, on American Geology, was praised for the facts, but (rather) censured for the theoretical errors, it contains. Mr. Challis's, on the theory of Capellary Attraction, was much (and, we think, most deservedly) eulogised. A distinction drawn by Mr. Challis between facts that are matter of actual observation, and facts that are the result of reasoning, is well deserving of attention. Mr. Challis remarks, that, while many questions in physics are to be resolved by unfolding, through deductive reasoning, the consequences of facts actually observed, there is also another class of questions in physical science, in which the facts that are to be reasoned from are not phenomena; for example, the fact of universal gravitation, for which the evidence is inductive, indeed, but yet essentially mathematical, the fact not coming itself under the cognizance of any of our senses, although its mathematical consequences are abundantly attested by observation. Mr. Challis goes on to say,—"The great problem of universal gravitation, which is the only one of this class that can be looked upon as satisfactorily solved, relates to the large masses of the universe, to the dependance of their forms on their own gravitation, and the motions resulting from their actions on one another. The progress of science seems to tend towards the solution of another of a more comprehensive nature, regarding the elementary constitution of bodies, and the forces by which their constituent elements are held together. Various departments of science appear to be connected together by the relation they have to this problem. The theories of light, heat, electricity, chemistry, mineralogy, crystallography, all bear upon it. A review, therefore, of the solutions that have been proposed of all such questions as cannot be handled without some hypotheses respecting the physical condition of the constituent elements of bodies, would probably conduce, by a comparison of the hypotheses, towards reaching that generalisation to which the known connexion of the sciences seems to point." The author finally remarks, that "questions of this kind have of late largely engaged the attention of some French mathematicians;

and the nature of their theories, and the results of the calculations founded on them, deserve to be brought as much as possible into notice." "Acting upon these just views (said Professor Hamilton), Mr. Challis has performed for the British Association and for the British public, the important office of reviewing and reporting upon those researches of Laplace, Poisson, and Gauss, respecting the connexion of molecular attraction, and of the repulsion of heat with the ascent of fluids in tubes." He thought it, however, but just to add—indeed, Mr. Challis himself does so—that, as "Newton first resolved the mathematical problem of gravitation, in its bearings on the motion of a planet about the sun, and went far to resolve the same extensive problem in its details of perturbation, so he likewise first resolved a problem of molecular forces, and clearly foresaw and foretold the extensive and almost universal application of such forces to the mathematical explanation of the more varied classes of phenomena." After Mr. Challis's Report came Professor Lloyd's on the progress and present state of Physical Optics; Mr. George Rennie's on Hydraulics; Dr. Henry's on the Law of Combustion; and Professor Clarke's on Animal Heat; all of which were more or less eulogised. The last volume of the Association's Transactions also included accounts of researches undertaken at the request of the General Committee, and of various recommendations emanating from them. Among the latter there was one to which the speaker felt it incumbent on him to invite the particular attention of the assembly. "I mean," said he, "that recommendation which advised an application to the Lords of the Treasury for a grant of money, to be used in the reduction of certain Greenwich observations, the result of which recommendation is noticed in the volume before us. In all that I have hitherto said respecting this Association, I have spoken almost solely of its internal effects, or those which it produces on the minds and acts of its own members. But it is manifest that such a society cannot fail to have also effects which are external, and that its influence must extend even beyond its own wide circle of members. It not only helps to diffuse through the community at large, a respect and interest for the pursuits of scientific men, but ventures even to approach the throne, and to lay before the King the expression of the wishes of this his *parliament of science*, on whatever subject of national importance belongs to science only, and is unconnected with the predominance in the state of any one political party. It was judged that the reduction of the astronomical observations on the sun, and moon, and planets, which had been accumulating under the care of Bradley, and his successors, at the Royal and National Observatory of Greenwich, since the middle of the last century, but which, except so far as foreign astronomers might use them, had lain idle and useless till now, to the great obstruction of the advance of practical as well as theoretical science, was a subject of that national importance, and worthy of such an approach to the highest functionaries of the state. It happened that I was not present when the propriety of making this application was discussed, so that I do not know whether the authority of Bessel was quoted. That authority has not at least been mentioned, to my knowledge, in any printed remarks upon the question; but as it bears directly and powerfully thereon, you will permit me, perhaps, to occupy a few moments by citing it. Professor Bessel, of Koenigsberg, who, for consummate theory and practice, must be placed in the very foremost rank—may be placed, perhaps, at the head of astronomers now living and now working—published not long ago that classical and useful volume, the *Tabulæ Regiomontanæ*, which I now hold in my hand. In the introduction to this volume of tables, Bessel remarks, that 'the present knowledge of the solar system has not made all the progress which might have been expected from the great number and goodness of the observations made on the sun, and moon, and planets, from the times of Bradley down. It may, indeed, be said, with truth, that astronomical tables do not err now by so much as whole minutes from the heavens; but if those tables differ by more than five seconds now, by using all the present means of accurate reduction—from a well-observed opposition of a planet, for example — their error is as manifest and certain now as an error exceeding a minute was in a former state of astronomy; and the discrepancies between the present tables and observations are not uncommonly outside that limit. The case is doubtful. Errors of observation to such amount they cannot be; and, therefore, they can only arise from some wrong method of reduction, or wrong-assumed elliptic elements or masses of the planets, or insufficiently developed formulæ of perturbation, or else they point to some disturbing cause, which still remains obscure, and has not yet been reached by the light of theory. But it ought surely to be deemed the highest problem of astronomy, to examine with the utmost diligence into that which has been often said, but not as yet in every case sufficiently established, whether theory and experience do really always agree. When the solution of this weighty problem shall have been most studiously made trial of, in all its parts, then either will the theory of Newton be perfectly and absolutely con-

firmed, or else it will be known beyond all doubt that in certain cases it does not suffice without some little change, or that, besides the known-disturbing bodies, there exist some causes of disturbance still obscure." And then, after some technical remarks less connected with our present subject, Bessel goes on to say—" to me, considering these things together, it appears to be of the highest moment towards our future progress in the knowledge of the solar system, to reduce into catalogues as diligently as can be done, according to the common system of elements, the places of all the planets observed since 1750—than which labour I believe that no other now will be of greater use to astronomy." Such is the opinion of Bessel; but such is not the opinion of an anonymous censor, who has written of us in a certain popular review. To him it seems a matter of little moment that old observations should be reduced. Nothing good, he imagines, can come from the study of those obsolete records. It may be very well that thousands of pounds should continue to be spent by the nation, year after year, in keeping up the observatory of Greenwich; but as to the spending 500*l*. in turning to some scientific profit the accumulated treasures there, that is a waste of public money, and an instance of misdirected influence on the part of the British Association. For you, gentlemen, will rejoice to hear, if any of you have not already heard it—and those who have heard it already will not grudge to hear it again—that, through the influence of this Association, what Bessel wished, rather than hoped, is now in process of accomplishment; and that, under the care of the man who in England has done most to show how much may be done with an observatory, that national disgrace is to be removed of ignorance or indifference about those scientific treasures which England has almost unconsciously been long amassing, and which concern her as the country of Newton and the maritime nation of the world; for the spirit of exactness is diffusive, and so is the spirit of negligence. The closeness, indeed, of the existing agreement between the tables and the observations of astronomers is so great, that it cannot easily be conceived by persons unfamiliar with that science. No theory has ever had so brilliant a fortune, or ever so outrun experience, as the theory of gravitation has done. But if astronomers ever grow weary, and faintly turn back from the task which science and nature command, of constantly continuing to test even this great theory by observation; if they put any limit to the search, which nature has not put; or are content to leave any difference unaccounted for between the testimony of sense and the results of mathematical deduction, then will they not only become gradually negligent in the discharge of their other and more practical duties, and their observations themselves and their nautical almanacs will then degenerate instead of improving, to the peril of navies and of honour; but also they will have done what in them lay, to mutilate outward nature, and to rob the mind of its heritage. For, be we well assured that no such search as this, were it only after the smallest of those treasures which wave after wave may dash up on the shore of the ocean of truth, is ever unrewarded. And small as those five seconds may appear, which stir the mind of Bessel, and are to him a prophecy of some knowledge undiscovered, perhaps unimagined by man, we may remember that when Kepler was "feeling," as he said, "the walls of ignorance ere yet he reached the brilliant gate of truth," he thus expressed himself respecting discrepancies which were not larger for the science of his time:—" These eight minutes of difference, which cannot be attributed to the errors of so exact an observer as Tycho, are about to give us the means of reforming the whole of astronomy." We, indeed, cannot dream that gravitation shall ever become obsolete; perhaps it is about to receive some new and striking confirmation; but Newton never held that the law of the inverse square was the only law of the action of body upon body; and the question is, whether some other law, or mode of action, co-existing with this great and principal one, may not manifest some sensible effect in the heavens to the delicacy of modern observation, and especially of modern reduction. It was worthy of the British Association to interest themselves in such a subject; it was worthy of British rulers to accede promptly to such a request."

The Presidents of the different sections then read abstracts of the business transacted and in progress in each, which our readers will find afterwards noticed under the head of the "Sectional Meetings." The meeting was honoured by the presence of the Lord Lieutenant and a brilliant suite. The number of persons present is stated to have amounted to nearly 2,000. Upwards of 700 new members had been admitted on the Saturday preceding, at a preliminary meeting of the General Committee, including—in himself a host, though with no pretensions to science—the first of Irish bards, Thomas Moore. On his being mentioned as a candidate, Provost Lloyd rose and proposed that he should be elected without the usual formalities or fees—a proposition which was carried with the most enthusiastic unanimity. Of foreigners there was but a small muster: M. Agassiz, Professor Mole, Dr. Peithman (Berlin), M. de Tocqueville (Paris), Count

Jarlsberg (Norway), Baron Barclay de Tolly, Dr. Hahn (Gottingen), Colonel Dick (New Orleans), &c.

Tuesday, August 11.

Dr. Lardner delivered a lecture of nearly two hours in length, on railways and locomotive engines.

Wednesday, August 12.

Professor Powell delivered a Lecture on the Phenomena of Prismatic Dispersion. These were first closely investigated by Newton, who traced the relation between colour and refrangibility. Dr. Wollaston, in 1802, and M. Fraunhofer, about 1819, observed that when the spectrum is formed by a very narrow beam of light falling on the prism, it is not only distinguished into colours, but these coloured spaces are marked by various dark lines or bands crossing the spectrum at all parts of its length, all parallel to each other, and to the original line of light; some few being much darker, better defined, and more conspicuous than others. Of the nature of these lines, the different appearances they assume, with different sorts of light, &c., the lecturer would say nothing, as (though highly interesting topics) they did not bear on his immediate question. He proceeded to refer to the use made of these lines as *marking definite parts* or rays of the spectrum. This is a matter of great importance for all accurate inquiry into the laws of the phenomena. Seven of the principal lines have been specifically named by Fraunhofer by the letters B, C, D, &c., and by these letters the definite or standard rays are now generally known. There is, at first sight, a little difficulty in identifying them. The professor, therefore, exhibited a drawing (done to a scale) representing these lines as they appear in the spectrum formed by a prism of water. By the light of day—*i. e.* of the clouds—the lines in the two extreme rays are invisible: if the full light of the sun be employed, they become so. Peculiarities in each were pointed out, by which they may be recognised. By means of these definite points, then, we can obtain accurate numerical measures of the deviation of the several well-defined parts of the spectrum—*i. e.* of rays of definite refrangibility. This was precisely the use made of them by Fraunhofer. By a calculation, well known to opticians, from these observed deviations, the index of refraction is deduced for each definite ray, and in the instance of each different substance of which the prism may be composed. Fraunhofer, with extreme accuracy, determined these deviations and indices for ten different media, viz. four kinds of flint-glass, three of crown-glass, water, oil of turpentine, and solution of potash. Thus we obtain those most essential elements for all physical inquiry, exact numerical data; and the series of numbers thus assigned showed, no perceptible agreement with any arithmetical relation. Diagrams were exhibited, illustrative of the different amount and character of the deviations for several media. To the same eminent observer we are also indebted for determining, with the greatest accuracy, another set of numbers characterising each of the same definite rays, viz. the values of those minute intervals (which, on the undulatory theory, are the lengths of waves), and which differ from the different rays, and whose real existence is a fact learned from the experiment of interferences, and totally independent of theory. The question then arose, Can any relation be traced between these and the former series of numbers? Now a certain formula had been suggested to the author by Professor Airy, as arising from the abstract mathematical researches of M. Cauchy, on the theory of undulations: he accordingly proceeded to reduce the formula to actual calculation, and found a very close agreement between the numbers which result upon this theoretical principle with those observed by Fraunhofer. Thus we obtain that great object, a mathematical law connecting the two series of numbers. But this is not all: the formula is one deduced from a peculiar view of the undulatory theory of light. That theory has hitherto been admitted to explain almost every fact in optics, except this of dispersion. By M. Cauchy's modification of it then, it is now shown to explain this also and what has hitherto been the greatest objection against it is thus far removed. This remark, however, applies only to the ten media examined by Fraunhofer. Will the same method apply equally well to others? This is the inquiry in which the author has been and is now intently engaged. His results are yet but little developed, but he mentioned one striking instance, viz. that highly dispersive substance, oil of Cassia, which he has examined after the method of Fraunhofer, and has (at least apparently) determined its refractive indices for the standard rays. He has worked out (also approximately) the necessary calculations, and found that in this strong case the same law applies with, at least, considerable accuracy.

Professor Whewell was next called upon to state the progress made in the extensive series of observations, lately commenced on the phenomena of the tides:—In June, 1834, observations had been ordered to be made by the coast-guard along the coasts of Great Britain and Ireland: returns had thus been procured from 500 different stations. The reduction of these had been only partially effected. In the paper which he held in his hand he had drawn up his conclusions from

these observations; they had done this much, that they had thrown great light on the circumstances attending the meeting of the two tides—the one which ran up the British Channel, the other (we believe) from the Northern Ocean. In June, 1835, fresh orders were issued to continue these observations along the same extent of British coast, and application for assistance had been made through the ministers of foreign powers; in every case they had been cordially met; and there was not a maritime state in Europe, not one north of the equator, that was not contributing its assistance to this great work: Sweden, Denmark, Russia, Spain, France, Holland, and the United States, had all joined in it. He could not but express his gratitude for the labours of one foreigner, who was now present, he meant Professor Moll, of Utrecht, who had furnished them with many very valuable returns from the coast of Holland—returns procured by much personal exertion.

Thursday, August 13.

Neither lecture, nor address, nor business of any sort, but "a promenade, with music and refreshments."

Friday, August 14.

The chairmen of the several sections gave reports of the proceedings of each during the week.

Saturday—Morning Meeting—August 15.

"During the week," says the *Athenæum*, "there were no interruptions to social harmony. On the contrary, men of every shade of political and religious opinion met together, and allowed all subjects of controversy to slumber. On Saturday, for the first time, the dawn was overcast. Circumstances occurred which awakened a suspicion that some interruption had taken place in the harmony which reigned among the members." The meeting at the Rotunda was delayed for more than an hour. At length, Mr. Vernon Harcourt, the General Secretary, addressed the meeting. After a few introductory words, in which he apologised for the delay which had occurred, he announced that invitations had been sent from Bristol, Liverpool, Birmingham, Manchester, and Newcastle, soliciting the Association to have its next meeting in those several places; and that it had been resolved to give the preference to Bristol, because of its being the first to send "a decided invitation." Mr. Harcourt then reported from the Committee the following recommendations:—

That a sum of 500*l*. be given for a duplicate reduction of the Astronomical Observation made at L'Ecole Militaire of Paris.

That small grants be given for constructing tables of the exponents of refracted indices, and organised observations of temperature.

100*l*. for determining the constant of lunar notation.

100*l*. for observations on the temperature of the tides.

250*l*. for continuing tidal observations in Liverpool and the Port of London.

100*l*. for the advancement of meteorology.

30*l*. for the continuation of Professor Wheatstone's experiments.

30*l*. for reducing to practice Dr. Jerrard's plan for solving equations of the fifth or higher degrees.

20*l*. to Mr. Johnston for completing his tables of chemical constants.

30*l*. to Mr. Fairburn for experiments on the hot and cold blasts in iron-works.

105*l*. for prosecuting researches into British Fossil Ichthyology; and the former grants for determining the amount of sediment in rivers, and the relative levels of land and sea, should be renewed.

That the zoology and botany of Ireland should be carefully investigated.

50*l*. for researches into the absorbents, and 50*l*. for examining the sounds of the heart.

That the Association should petition the Government to send an expedition to explore the Antarctic regions, and determine as accurately as possible the place of the south magnetic pole.

That E. Halsewell, Esq., be requested to prepare a tabular return of the inquests held during the last seven years in as many counties as possible; and further, to procure a statistical report of Hanwell Lunatic Asylum.

That the Reports of the Secretaries of Sections be officially supplied to the *Philosophical Magazine*, of London, and the *Edinburgh Journal of Science, on condition of copies being supplied to the Secretaries.**

That an effort be made to establish a law of universal copyright.

Mr. Taylor, the Treasurer, then read a statement of the financial concerns of the Association. On the 30th of July last, there

* Would it not have been more consistent with the character of universality, so earnestly claimed for the Association by Professor Hamilton, had this recommendation been extended to *all* the scientific journals? A surer way, too, of promoting the purposes of the Association, which can be forwarded by nothing so much as by the widest possible publicity being given to its proceedings? Both the favoured journals do not together circulate one quarter so many copies as one of the excluded (which it is not for us to name). As the recommendation stands, however, the proprietors of the *Philosophical Magazine* and *Edinburgh Journal* are very welcome to all the advantages it can bring them. Gratis copies to all the subscribers, that is, to all the members of an Association now amounting to between 3,000 and 5,000, if not more, must, we imagine, be paying rather dear for the whistle. It is little to the credit of the Association that they should have made any such stipulation.

was cash in hand 509*l*., 2,361*l*. 3 per cent stock, and unsold copies of works about 560*l*. In Dublin the Treasurer had received from 1,228 subscribers, in subscriptions and compositions, 1,750*l*., together with an additional sum of 94*l*. for books sold, making the total amount 5,214*l*. The expenses and sums due by the Association were 1,000*l*., leaving a clear property of 4,214*l*. It might be pleasing to the audience to state, that the receipts of the preceding year in Edinburgh were 1,626*l*., while in Dublin they amounted to 1,750*l*. It was also very gratifying to be able to state, that grants for the advancement of science, of 1,700*l*., had been placed this year at the disposal of the Committee.

Votes of thanks were then passed to the Lord Lieutenant, the Provost and Fellows of Trinity College, the Royal Dublin Society, the Royal Irish Academy, the Royal Colleges of Physicians and Surgeons, and several other public institutions, for the hospitable attentions they had respectively shown to the members of the Association, individually and collectively.

Professor Whewell, in proposing the vote of thanks to the Provost and Fellows of Trinity College, announced that they had conferred the honorary degree of LL.D. on Professor Mole, M. Agassiz, Mr. Wm. Smith (the eminent geologist), Sir Thomas Brisbane, and Mr. Baily.

Votes of thanks followed to the President and other officers of the Association; and now, at last, came that thunder, the under growl of which had disturbed the morning's calm. It fell to the lot of Dr. Robinson, of Armagh, to propose the vote of thanks to Mr. Vernon Harcourt, the Secretary, whom Dr. Robinson had eulogised at the last annual meeting as being also *the founder* of the Association. For this the Doctor was censured in an article in the *Edinburgh Review* for January last, in which the honour of originating the Association was claimed for Sir David Brewster, who is generally supposed to have been himself the writer of the article. The opportunity which the present speechifying afforded of replying to the reviewer was too tempting, it seems, to be resisted; not the less so, perhaps, that Sir David's absence from the meeting left his detractors an extremely clear field. How well they availed themselves of it, we shall leave our judicious contemporary, the *Athenæum*, to relate. "In the course of the speeches," says that journal, "many neither very courteous nor very sensible allusions were made to reviewers generally.* It is not our purpose to defend the craft; at this time of day such charges require no refutation; but in moving the thanks of the Association to Mr. Vernon Harcourt, Dr. Robinson attacked the Edinburgh Reviewer in a style and temper which proved that he at least is not qualified for a critic. One specimen will perhaps suffice. Speaking of Mr. Harcourt, he said, "In his presence I will not say what he *is*, but I will say what *he is not*; he is not a man who made use of the Association as a means of obtaining title and fortune—he is not a man who, having reason to complain of our proceedings, instead of making his charges in the face of day, would wield the *concealed dagger of a lurking assassin*."

No shouts of indignation are stated to have followed this savage denunciation. We wonder there did not; for in so large an assembly there must have been many men of lofty minds and generous feelings. The assertion, that Sir David Brewster is indebted for his "title and fortune" (*such as they are*, a paltry knighthood and paltrier pension) to the British Association, is not simply incorrect—it is ridiculously untrue. Brewster had established for himself by his scientific labours a title to far higher rewards than any he has received, or is ever (we fear) likely to receive, long before the British Association was in existence, or even dreamt of. The charge against him of acting like an assassin is still worse—it is monstrous. He has not signed his name, it is true, to the review complained of, yet neither has he disclaimed it; no person, it is evident, doubts from whom the blow proceeded—what ground, then, for imputing either stealth, or secrecy, or surprise? If Sir David Brewster is to be talked down as an assassin because he has penned an anonymous review, then we must learn to consider as equally of the assassin crew, nine out of ten of all the eminent men of science and letters of the times in which we live. The outcry, it is worthy of remark, is all about the authorship of the article—not a word about the substance of the article itself. We have a shrewd suspicion that had it been a dagger of lath which the reviewer wielded, we should have heard nothing of his cloak. The dagger seems to have been one of good steel—reasonably sharp and piercing—favoured, perhaps, by the extreme tenderness of the parts at which its blows were directed, but still a thing, under any circumstances, to be dreaded, and *therefore* with might and main protested against. But we are forgetting, in the warmth of outraged feelings, the sort of duty which we prescribed to ourselves in this

* One by Mr. Harcourt himself was of pre-eminent silliness. "A friend," said he, "once asked Dr. Black, 'How do you happen to have made important discoveries, and then stop short, instead of completing those inventions, as Priestley and Watt have done?' 'They have not escaped me,' was the reply, "but I am afraid of the reviewers." That is to say, Black refrained from discovering oxygen, and inventing the steam-engine, for fear of the reviewers!!! Bah!

article, which was not that of annotators, but simple chroniclers; let us, therefore, resume the thread of our more sober narrative.

Farewell Banquet.

In the afternoon of Saturday the Provost and Senior Fellows of Trinity College gave a farewell banquet to the members of the Association in the examination-hall of the University. Before sitting down to dinner, the Lord Lieutenant, one of the invited, addressed Professor Hamilton, to whom it was previously intimated that his Excellency was desirous of conferring on him the honour of knighthood, in the following terms :—" This is an exercise of one of those prerogatives of royalty, of which I am here the representative, most grateful to myself—most in unison, I feel, with the wishes of that gracious Sovereign on whose behalf I act—most in accordance, I am equally persuaded, with the unanimous opinions of that enlightened people, for whose benefit all power is intrusted. This act does not so much confer distinction, as place the royal, and therefore national, stamp upon that distinction, which has already been acquired by personal qualifications and individual exertions. On all these grounds, it is with the highest pleasure I now announce to you my present intention, more particularly in connexion with this occasion, where you fill a high official situation in that Association, as members of which we are now here congregated—in the presence of foreigners by birth, strangers to each other in social ties, who are nevertheless drawn together by the irresistible attraction of mutual enlightenment. It is from this brotherhood of knowledge that, as Ireland's viceroy, I step forward to claim you as her own, and to appropriate to the land of your birth your distinguished reputation; and this I do, sir, because, apart from every other consideration, I recognise in the expansion of intellect and the development of science the surest sources of the eternal triumph of truth."

The Professor then knelt down,—Lord Mulgrave took the sword, and placing it upon the Professor's shoulder, said, " I, Ireland's viceroy, bid you rise Sir William Rowan Hamilton !"

The after-dinner speeches offered nothing remarkable—unless it might be, some displays of eloquence, which, in any country but Ireland, would have been deemed worthy of everlasting remembrance. The Rev. Dr. Singer is stated in the *Literary Gazette* to have made on this occasion " perhaps the most eloquent speech of the week," in proposing the healths of " the foreign Associates; and we have heard it spoken of in still higher terms by some friends who were present.

Saturday—General Evening Meeting.

Dr. Barry gave a relation of his ascent of Mont Blanc in the summer of 1834; the details of which have already been published. He mentioned that he did not experience any difficulty of breathing in the higher regions of the mountain, although previous travellers have complained of suffering very much from that cause. Only twenty persons, he said, had been known to reach the summit of Mont Blanc; and of those twelve were Englishmen.

Mr. Babbage made some remarks upon a whirlpool found in the island of Cephalonia, through which the sea has poured for forty years. He had applied to Lord Nugent, the governor of Corfu, to know whether he was acquainted with the fact; and that nobleman gave him a statement upon the subject, which he would endeavour to report, although, perhaps, not with sufficient accuracy, as he had not taken notes at the time. A hole is seen between two rocks, and an excavation being made, the sea which enters is conveyed through a channel into a pit 100 yards round and four feet below the sea. There is a perfect deposit of salt water in this pit, and the sea that enters rushes in with considerable velocity. The water rises in the pit through the sluice to the height of two feet, and is then discharged through some means not yet ascertained. Mr. Babbage said, that the water which disappeared probably went into vast hidden receptacles, for otherwise, the volcano agency supplying heat would, as the waters descended into the earth, cause eruptions.

Mr. Wheatstone exhibited and explained the construction of his speaking automaton, and with that the General Assembly Proceedings of the British Association for the session of 1835, closed.

Sectional Meetings.

MATHEMATICS AND PHYSICS.

Rev. Dr. Robinson, President.

Mr. Whewell read the first part of a report upon the " Mathematical and Dynamical Theories of Electricity, Magnetism, and Heat." In the opening of it he gave a slight sketch of the history, explained briefly Franklin's Theory, and described the reduction of this theory to mathematical language by Alpinus. Although this theory, at first sight, appeared simpler than the theory of two fluids, soon after maintained by Coulomb and by Poisson, reduced to the precision of a mathematical science, yet, in truth, it was more complicated; since, to explain certain phenomena, particularly the repulsion of two negatively electrified bodies, in conformity with the theory of Franklin, it was necessary to add a second hypothesis—viz. that " the par-

ticles of bodies themselves, when stripped of any portion of the electric fluid, repelled each other;" which hypothesis seems to be inconsistent with the well-established fact of the universal gravitation of all particles of material substances. The author then detailed the most material results of the experimental researches of Coulomb, and showed the beautiful accordance of them with the mathematical investigations of Poisson, particularly dwelling upon, first, the law of attractive and repulsive influence at a distance, which both proved to be the same as gravitation, viz. the inverse square of the distance; and, secondly, the distribution of electricity upon the surfaces of electrified bodies of various shapes, on which surfaces alone electricity can manifest itself. He then detailed, and highly eulogised, some late experiments by Mr. Snow Harris, of Plymouth; and concluded the electrical portion of his report, with an examination of the accordances and disagreements of the results of these celebrated men.

The author then proceeded to the magnetical portion of his report. First, he touched slightly on the experimental researches of Gilbert and the earlier philosophers; then detailed the advancement of the science to mathematical dignity in the hands of Alpinus; next, the exact experimental results of Coulomb's investigations, and the law of the force and distribution along a needle, from one pole to the other; lastly, he touched upon the remarkable results of the experiments of Mr. Barlow as to the law of the action of masses of iron on the magnet, showing that these results were confirmed by the mathematical speculations of Mr. Bonnycastle, who showed that the laws discovered by Barlow were correct and simple results of the theory, and that the magnetic influence could alone, as, in fact, was found to be the case, manifest itself upon the surface of masses of iron. From the knowledge of these laws resulted the compensating plate of Barlow for neutralizing the effects of ships' iron on the compass, and thus securing mariners from a most dangerous source of error.

Mr. Snow Harris rose and stated, that he conceived the mode of experimenting adopted by Coulomb was subject to a source of error not hitherto noticed—namely, that the proof plane of Coulomb became itself electrified by induction as it approached the body, the electricity of which at the various parts of its surface was to be examined, and that the shape of the body at the several points to which the proof plane was made tangent, most materially affected the quantity and tension of the electricity developed upon it; in consequence of which, he conceived that the laws of distribution deduced from the experiments of Coulomb were not to be depended upon.

Mr. Whewell conceived, that as the tangent or proof plane was very small, and the same proof plane applied successively to the several parts of the surface, the comparative results must be correct.

Mr. Harris dissented, stating that he would soon have an opportunity of bringing his view more in detail before the section.

Professor Stevelly requested to know from Mr. Whewell, whether he conceived Coulomb to be the first person who promulgated the theory of two fluids in electricity? Professor Stevelly stated that he held in his hand a book, printed in 1771, "Philosophical Essays," by Henry Eels, Esq. of Waterford, in which he publishes letters sent by him to the Royal Society of London, and complains that Dr. Priestley had not given them earlier publicity. In a letter, under the date of 12th April, 1756, he clearly gives the theory of two electrical powers or fluids, experimentally establishes their existence and diversity of properties, points out truly the modification required in the law of attraction and repulsion, as given by Franklin, in order to harmonise his law with the experimental facts produced by himself, to establish the theory of two fluids, which is esteemed much more modern, and gives some excellent views of magnetical phenomena. Professor Stevelly also stated, that in a previous letter, dated 18th June, 1752, he had given very strong reasons for concluding, that the cause of thunder and lightning was identical with electricity, and had even produced an electrical theory of the suspension of vapour and falling of rain.

Professor Whewell explained, that his statement only had reference to the theories as mathematically developed.

Mr. Snow Harris then read an interesting paper upon a new balance, adapted to measure most minute indications of force, and reduce them readily to weights; an instrument much better adapted to experimental researches in electricity, than the torsion balance of Cavendish and Coulomb. The defects of the torsion balance, as he found, were:—1. That the received law of torsion, though perhaps true in hypothetical cases, in practice could not be depended on. 2. Where this law was most to be depended upon, the angle of torsion for the smallest forces was so large as to require adjustments of the instrument difficult to be obtained, and little to be depended upon. 3. The instrument was very unsteady, and required too much time to work its indications. His instrument consisted essentially of a needle, reed, cylinder, or bar, suspended by two distinct parallel and vertical fibres of silk. When this bar is turned round the centre, the suspending threads being brought into an oblique position, its centre of gravity is compelled to raise

the weight of the bar; and, therefore, tends to bring it back to its previous position, with a force directly proportioned to the angle of torsion in a given instrument, and bearing a very easily-determined proportion to the weight of the instrument, the length of the suspending fibres, and their perpendicular distance. He then exhibited models illustrative of the principles and formularies which he had detailed, and produced and explained the neat and ingenious adjustments of a highly-finished instrument of this description, exhibiting some interesting electrical experiments, showing its use, and illustrative of its extreme sensibility. The exhibition and description of this instrument, called forth the strongest expressions of applause from the section.

Professor Powell read a paper on the radiation of heat. He commenced by giving a succinct account of the late researches of Melloni and of Forbes; stating, that Melloni had failed in establishing the polarization of heat from the luminous bodies; but Forbes, by the use of a much more delicate apparatus, the thermoscope, had triumphantly established the fact. Melloni had tried his experiments on heat, derived from the sources of—1. heat of a lamp;—2. incandescent platina;—3. brass heated by a lamp;—4. copper so heated as not to be luminous. Melloni had established the fact, that the *ratio* of the heat transmitted through screens is *different* for luminous and for non-luminous bodies; and hence concludes, that the material of heat exists in two essentially distinct states, or that there are two kinds of heat—1. that heat whose type we have from the sun, and other self-luminous bodies;—2. the heat whose type we have from boiling water, and other non-luminous bodies.

Dr. Hudson also read a paper on the Radiation of Heat, and described a differential thermometer, much more sensible than Leslie's, made with sulphuric ether, coloured with dragon's blood. The chief peculiarity of his experiments, consisted in his heating the mirror used for reflection; he tried the diathermocy of rock salt, and confirmed a conclusion of the previous paper. He stated, that his experiments on the radiation of cold could not be accounted for on any theory but the undulatory; and ended by stating, that the zeal caused by the approach of the British Association, was the mainspring of his exertions in this field.

Sir John Ross read a paper on the origin of the Aurora Borealis; the result of a twenty-five years' reflection on the subject: he having frequently noticed, that the Aurora took place *between* two not very distant ships, also between the ship and an iceberg. He concluded, long since, that Wollaston's opinion, that this meteor took place at great altitudes, must be erroneous; and he came to the conclusion, that it was caused by the sun's rays striking on the circumpolar fields of ice and glaciers, and then reflected from very thin clouds aloft in the atmosphere.

Mr. Mallet described a very ingenious instrument on the principle of a magnet, formed instantly by electricity, and then again discontinued, for separating the iron and brass and copper filings, that become mixed in manufactories.

Mr. Whewell read the second part of his report on "The Mathematical and Dynamical Theories of Electricity, Magnetism, and Heat," being that which embraced the subject of Heat. His views on several points presented no small degree of novelty. The sun, according to the learned Professor, is, from day to day, pouring upon the earth a quantity of heat: this, as it descends, by the conducting powers of the parts of the earth, follows certain laws of increase and decrease; and the entire quantity of each year descends to a certain depth, where it is succeeded by the quantity thrown upon the earth in the preceding year, which had not yet been dissipated; below that lies the stratum occupied by the solar heat of the preceding year, and so on, until at length, at a certain depth, this solar heat ceases to be perceptible. He showed that the mean annual quantity of this solar heat was such as would melt fourteen metres of ice encircling the entire surface of the earth. He next considered the *central* heat of the earth, and the experiments and observations by which its existence was placed beyond doubt, and the law of its distribution, as it ascended to the surface, traced; and he stated that the issue from the surface at each part was so much in a century as would be capable of melting three metres of ice heaped upon that surface. He then discussed the subject of cosmical heat—showed the probability that the regions of space were not of a uniform temperature: and hence he concluded, that all the bodies of the solar system had a tendency to acquire the temperature of that part of space in which they are placed; and that the heat of the planetary spaces was only about 50° below the freezing point.

Dr. Allman (Professor of Botany) read a paper on the forms of the cells of plants.

Mr. Snow Harris was then called on by the President, and gave an interesting account of his views of electrical action and distribution. He first described some entirely new apparatus by which the most exact quantitative measures of the charges given to electrified bodies, as well as the attractive forces exercised by them on each other, reduced to indications or measures by weight. Mr. Harris performed a number of curious and interesting experiments with this ap-

paratus before the Section, by which he clearly proved certain laws of direct and reflex actions of electrified bodies, which, he conceived, were at variance with certain results of Coulomb and of the mathematical theories of electrical action. Mr. Harris also described another delicate instrument, in which an index, mounted on friction-wheels, was caused to traverse a graduated arc, by a pulley on its axis, one end of the silk thread round which carried the electrified body; at the other end a small counterpoising cylinder of varnished wood, which dipped into a vessel of water, acted as a means of estimating the force of attraction, by the alteration of the buoyant force of the fluid exerted upon it, as it became more or less immersed.

Dr. Read of Edinburgh read a paper on the form and construction of buildings intended for public assemblies, in which no more than one echo should be heard. He illustrated his views of the propagation of sound by several facts, not generally known, from which it appeared that the subject is as yet but little understood. Dr. Read recommends that in all large rooms, like the House of Commons, where it is necessary to preserve the tone and enunciation of the speaker, the walls should be built as low as possible, to diminish the reflection of sound, or echo, and made as rough as possible, by ornaments or other means. Several observations were made by different persons in confirmation of Mr. Read's views; from all of which it followed, that the lower and rougher the walls, the less their effect in injuring the intonation; and thence the propriety of fluting, or fretting, walls of rooms intended for public meetings. For the same reason, the floor should also be roughened, by carpeting, or sand, or turf-mould, or saw-dust, or some such material, which would, as it were, absorb the sound reflected from the ceiling, which should be made to act as a sounding-board, to give "body" to the voice.

Mr. Russell followed with an explanation of the improvements effected in inland navigation by the swift passage boats, and the experiments and principles on which these improvements were supposed to be founded.

MECHANICAL SCIENCE APPLIED TO THE ARTS.

The great press of business in the Mathematical and Physical section rendered it necessary this year to institute a sub-section for the Useful Arts, and the increasing interest felt in the subject of Civil Engineering, induced the General Committee of the Association to establish it as a permanent section of their body. Mr. James Rennie was appointed President, and Dr. Lardner, Vice President.

Mr. Eaton Hodgkinson reported to the Section, the result of certain experiments on impact, made in continuation of that valuable series of experiments, which he had communicated to the Association at the three previous meetings. They were to the following effect: 1. That cast iron beams being impinged upon by certain heavy masses, or balls of different kinds of metal, but of equal weights, were deflected through the same distances, whatever was the nature of the metals. 2. That the impinging masses rebounded after the stroke through the same distance, under similar conditions. 3. That the effect of the masses of different metals impinging upon an iron beam, is entirely independent of their elasticity, and is the same, as theory would give, if these impinging masses were inelastic.

Mr. Hodgkinson gave also the result of some very curious experiments, on the fractures of wires in different states of tension; from which it resulted, that the wire best resisted fracture and impact when it was under the tension of a weight, which, being added to that upon it, equalled one-third of the weight necessary to break it.

Mr. Pritchard exhibited an acromatic microscope, made by him on the principles published in his works, in which the angular aperture of the Object Glasses exceeds any that have yet been produced. He briefly stated the advantages derived from it in the examination of the structure of bodies, especially the materials of textile fabrics—as flax, cotton, silk, &c.

Mr. Ettrick read an account of a Mariner's Compass, which by two adjustments caused the cardinal points on the card to coincide with the corresponding points of the horizon, whereby the mariner is saved the trouble of allowing for the variation in steering, and the necessity of purchasing expensive variation plates. It was effected by securing the needle upon the card by moveable clamps, and adjusting such needle for the magnetic variation of Greenwich, with a contrivance for changing it in places having a different local variation.

Mr. Russell read a paper on the solids of least resistance, with reference to the construction of steam vessels, and detailed several experiments to prove, that the object would be best attained by giving a parabolic form to the prow. Some doubts were expressed, as to the scientific principles by which this theory was supported, by Professor Mosely and Dr. Lardner.

Mr. John Taylor made a communication respecting the monthly reports of the *duty* of steam-engines, employed in draining the mines of Cornwall. These reports gave the means of comparing one engine with another in the district; they also afforded an histori-

cal view of the progress of improvement in this important machine; and they had, as Mr. Taylor believed, contributed largely to that improvement, by the emulation and attention excited by them, in the persons who had the charge of constructing and managing the engines. Mr. Taylor stated, that the work done in the best engines now employed in Cornwall, by the consumption of one bushel of coals, required ten or twelve years ago the consumption of two bushels; that during the period of Bolton and Watt's patent, four bushels were consumed to do the same work; and that in the earlier stages of the employment of steam-power, the quantity of coal used was 16 bushels. He said, that the steam-engines now at work for draining the mines in Cornwall, were equal in power to at least 44,000 horses. He testified to the accuracy of the duty reports, declaring that he had compared them with the account books kept at the different establishments, and found that the results of both coincided.

Dr. Lardner delivered some observations upon railroads. He had before stated, in his lecture at the Rotunda, that the perfection of a railroad would be to have it entirely and unqualifiedly level. The learned lecturer, after adverting to the abrupt curve at the termination of the Kingstown Railway, the radius being not more than half a mile, instead of at least being one mile, concluded by saying, that in any case it would be most essential to avoid having any curves at the termination of a descent.

Mr. Vignoles, the engineer of the Kingstown Railway, detailed several instances coming under his own observation, to show, that, in railways where the curve was less than a quarter of a mile, no danger had ever occurred. Dr. Lardner's views on the subject appeared to be formed on the supposition, that, at these curves, the rails were perfectly level, but this was not the case. The alleged lateral friction on the rails at Kingstown, Mr. Vignoles declared to be imaginary, as on examination it would be found, that the flanges of the wheels, by the proper adaptation of the levels of the two rails had not rubbed the sides of the rail more at the curve than in any other part. Mr. Vignoles also observed, that, although it might be desirable to have railroads with an inclination of not more than one foot in 250, yet a greater inclination should not be objected to. It was impossible to construct many or long railways, if the directions of Dr. Lardner were to be followed to the letter. The opinions of the Section on the point in dispute between Dr. Lardner and Mr. Vignolles were much divided; but the majority seemed to agree with the latter, that curves and acclivities are not so injurious as has been generally supposed.

Mr. Cheverton read a paper on mechanical sculpture, or the production of busts and other works of art by machinery; and illustrated the subject by specimens of busts, and a statue in ivory, which were laid on the table. They were beautifully executed, and excited universal admiration. The machine, like many others, produces its results through the medium of a model, to govern its movements, but it has this peculiarity, that the copy which it makes of the original may be of a size reduced in any proportion; and that it is enabled to effect this result, not merely on surfaces such as bas-reliefs, but in the round figure, such as busts and statues.

Professor Stevelly described a self-registering barometer. The Professor also showed, that an extremely cheap, sensible, and easily-constructed instrument, for weighing hydrometrically, could be obtained, by using, as a stem, a steel wire with a gold dot or two on some part of it; an index, or a microscope, with cross wire being attached to the side of the vessel, in which the hydrometer floats, capable of being moved steadily up and down until it bisects the gold dot, intead of taking the common method of indications from the surface of the fluid. The weight is obtained by placing the substance in the scale of the hydrometer, bringing the index or wire of the microscope to mark the position of the dot, removing the substance, and putting in known weights until the dot is again brought to the same position.* As the adjustment takes place at the instant of using, the instrument becomes almost incapable of being injured by external violence. The common hydrometer, as every one knows, is destroyed by a very slight external injury.

CHEMISTRY AND MINERALOGY.

Dr. Thompson, President.

Mr. Davy read a paper on the best method of Protecting Iron from the action of Salt Water. He purposes to attach portions of zinc to the iron, which will cause an alteration in the electrical state of the iron.

Mr. Fox made a statement relative to the effects of iron, when strongly heated, on the magnet: he mentioned, that when iron was let run in a state of fusion into a trough, near which was placed a magnetized needle, no effect was observed on the needle, until the iron has cooled down to a low red heat, and that then the needle was strongly

* The principle is the same as that of Biot's plan of weighing accurately, even with an imperfect balance; but the hydrometrical application of it is new, and extremely ingenious.—*Athenæum.*

attracted. He considered this observation to be of great importance to the geological discussions relative to central heat.

Dr. Daubeny communicated to the Section the interesting fact of the discovery of carbonate of magnesia in lava, immediately after the recent eruption of Vesuvius, which must consequently have been sublimed at a high temperature.

Mr. Snow Harris exhibited a newly-invented electroscope of extremely sensible and accurate construction, and demonstrated to the Section the fact, denied by Pouillet, that electricity is developed by the evaporation of pure water.

A communication was made by *Mr. Hartop* relative to the use of hot-air in iron blast furnaces in Yorkshire, in which he stated that this mode of supplying the smelting furnaces possessed but few advantages, and also deteriorated the iron, which had consequently fallen much in value. This gave rise to a conversation, in which several gentlemen stated that the price had not been so diminished in other parts of the country.

Dr. Dalton made a communication relative to the atomic theory, and the mode of notation most worthy of adoption by chemists. He distributed among the Section several lithographed copies of a series of symbols adopted by him to represent the most important chemical compounds. A very animated discussion arose from this communication, in which Mr. Whewell and Mr. Babbage joined, relative to the use of a notation; and from the whole of the proceedings on this subject, it appears that an adherence as far as possible to algebraical formulæ, in preference to the Berzelian notation, seems most likely to receive the sanction of British chemists.

Mr. Mallet showed specimens of a pulp fit for the manufacture of paper, obtained from turf, and explained the mode of preparing and bleaching it.

Mr. Scanlan gave an account of a new product obtained from the destructive distillation of wood.

Dr. Barker detailed a new mode of precipitating the peroxide of iron from its solutions, by means of the acetate of potash, and showed its application for the purpose of obtaining a pure salt of manganese.

GEOLOGY AND GEOGRAPHY.

Professor Sedgwick, President.

Mr. Griffith laid before the meeting his coloured Geological Map of Ireland, and proceeded to explain it at great length. He pointed out, as particularly worthy of observation, the similarity, he might almost say, identity of the formation of some parts of the eastern coast of Ireland, and the western coasts of England and Wales; he hoped the time was not far distant when there would exist the same identity of feelings and interest between the two countries.

Archdeacon Verschoyle read a paper on the trap-dykes of the counties of Mayo and Sligo, of which he observed there were no fewer than eleven, some of which he had traced from twenty to forty-five miles.

Professor Sedgwick expressed his conviction, that the effect of trap-dykes on limestone, was to convert it into dolomite, that is, to develope in it magnesian earth, but how such change was produced, he left the chemists to explain.

Mr. Murchison hoped some Irish geologist would investigate the existence of igneous rocks, interstratified with sedimentary deposits, which, as he believed, were yet unknown in Ireland.

Mr. Greenough thought the arguments inconclusive, which are generally adduced in favour of the recent elevation of many mountain chains. But from this view, Messrs. Murchison and Sedgwick dissented.

Mr. J. Bryce showed, that when columnar trap is present in the north of Ireland, chalk and other secondary rocks are *generally* absent, and that the Giant's Causeway does not, as is commonly supposed, rest on chalk rocks.

Professor Phillips communicated a paper on belemnites.

Professor Agassiz showed that belemnites differed from recent cuttle-fish chiefly in the superior development of particular organs, and added some highly curious particulars concerning the organization of these animals.

Dr. Trail read a paper on the Geology of Spain.

Mr. Smith, of Jordan-hill, gave an account of a fossil forest near Glasgow. It is seen at the aqueduct over the Kelvine River, and consists of a number of trees standing in an upright position, and throwing out roots in all directions, just as if they had grown on the spot. They rest on nearly horizontal strata of sandstone at the bottom of a quarry, and terminate upwards at the height of a few feet, as if cut right across. The trees are all dicotyledonous, and some of them are so near one another, that it is difficult to conceive how they grew.

Professor Sedgwick explained that, as all the trees were most probably of the fir tribe, they might have been nearly bare of branches and have grown close together.

Professor Whewell made a communication on the bearing of questions in natural philosophy and mathematics on geological inquiries. A base line or standard sea-level is necessary to the geologist, and yet is not

fixed, as high and low waters are variable. Again, the double motion by which the two north magnetic poles seem to revolve round the pole of the earth, seems to imply causes which may serve the geologist in explaining his revolutions, particularly as they take place in periods which, though never more than 4,000 years, bear a comparison with the periods he contemplates. Further, the laws of heat, particularly those relating to its diffusion through the earth, are of extreme importance. Poisson, not believing in the former fluidity and present central heat of the globe, proposes a new theory, which has just been published. He considers that space, through which the sun and whole system are moving, is not of uniform temperature, and that the earth may therefore at different times be subject to different degrees of heat. The temperature of the globe at any time will be that of the space left, because heat requires time to pass into the interior parts through the solid crust.

Professor Phillips afterwards mentioned, as an interesting fact, that Necker had determined that the direction in which the strata of rock range all over Europe is the same as that of the lines of equal magnetic intensity.

Mr. Hartop read a short notice concerning the Yorkshire coal-field. It consisted of a description of a great horizontal heave of the carboniferous series, which was explained by Professor Sedgwick as being the result of a fault in beds of mean inclination, and of the subsequent abrasion of the superior strata.

Professor Sedgwick and *Mr. Murchison* then brought forward an elaborate memoir on the stratified deposits in England, inferior to the old red sandstone, and on which they have been occupied four or five years. Mr. Murchison's part was the border counties of Wales and England, Professor Sedgwick's comprised North Wales and Cumberland. Mr. Murchison has discovered extensive deposits ranging over a wide tract which were before entirely unnoticed, but which he has found teeming with fossils, many of them of new and varied forms, and all of a perfect organization, and much higher in the chain of being than it was formerly supposed such ancient deposits could have contained.

ZOOLOGY AND BOTANY.

Dr. Allman, President.

Mr. Niven submitted a plan for the natural arrangement of plants.

Mr. Mackay (Curator of Trinity College botanic garden) stated, that while in the neighbourhood of Killarney, he was informed that an extraordinary species of large "black frog" existed in considerable numbers there; supposing he was about to witness a new variety of the species, he proceeded to open an old wall, where he found several full-grown toads. This fact, opposed as it is to the general disbelief of their existence in Ireland, occasioned considerable sensation.

Mr. Stannage read an account of the dis-discovery of a toad in a fragment of sandstone rock, at Park Gardens, Coventry, during the excavations at present in progress: the animal was re-inclosed in his "narrow bed" by the engineer, but it only survived four days.

Dr. Barry, who ascended Mont Blanc in the autumn of 1834, described some interesting observations made by him on the modifications of the apparent colours of the sky, as depending on the rays transmitted to the eye from the surface of the earth. When surrounded with snow at a very great elevation the sky assumed a dark violet colour, which became changed to the light azure, with every intermediate tint, in proportion as he entirely or partially excluded the rays emanating from the earth. These shades, and the corresponding influences which gave rise to them, he exhibited in an ingeniously-constructed table, and illustrated the results by the application of the physical laws of light. A conversation ensued on the laws regulating the re-combination of luminous rays after the decomposition of the compound ray has taken place. Doctor Jacob proved by examples, that these modifications were influenced, as far as sensation went, by physical conditions in the state of the retina.

Mr. Mackay introduced to the notice of the Section the extraordinary longevity of the yew-tree. He produced a section of this species, which proved that the tree from which it was taken must have been upwards of 500 years old; he stated that the beautiful variety known as the Florincourt, was indigenous to Ireland. Another member adduced the example of the well-known stump near Bangor, which was calculated to be more ancient than the Christian Era. Mr. Mackay read a paper in which he described several new species, not hitherto known as existing in Ireland. An interesting conversation ensued, on the modifying power of locality on the same species, and on the locality of plants generally.

Professor Graham, at the evening meeting at the Rotunda, took occasion to say that there was one plant of Irish growth which Mr. Mackay had neglected to mention; it was a singular and beautiful specimen; he alluded to that open-hearted, open-handed, warm hospitality which he, in common with all visitors had experienced since their arrival in Ireland. (Cheers.) He hoped it was not a *genus* peculiar to Ireland—(cheers and laughter)—but every phlegmatic Scotchman must have been struck with the hospitality they experienced in Ireland.

ANATOMY AND MEDICINE.

Professor Collis, President.

Dr. Graves read a paper on the use of Chloride of Soda in fever.

Mr. Houstoun another on certain Peculiarities in the Circulating Organs in Diving Animals.

Mr. Harrison read a Report of the Dublin Committee on the Motions and Sounds of the Heart. A long discussion on the subject of this report ensued between Dr. Williams, Dr. Corrigan, Dr. Macdonnel, Mr. Carlisle, &c.

Mr. Snow Harris, of Plymouth, exhibited the bones of the lame hip-joint of the late lamented Charles Mathews; and Mr. Houstoun, the skulls of Dean Swift and the celebrated Stella (Mrs. Johnston).

The following remarks in the *Literary Gazette* on these exhibitions do it great credit:—"How far science can be promoted by such spectacles we cannot tell; but, allowing for every apology made for them, we cannot but consider them to be repugnant to the best feelings of human nature. In ourselves, the bare mention of the exposure of the partial skeleton of our great comic favourite and friend, while yet only 'festering in his shroud,' excited a degree of pain and distress which no settlement of a point of anatomical or medical curiosity could qualify. Whether the shortening of his limb was caused by fracture, or by the rare disease called *Morbus coxæ senilis*, induced by the fall from his gig, might well have been left unexplored; and, at all events, if the inquiry had been made, it ought to have been made in private, and the result alone communicated to such of the profession as it could interest and guide. But to make a common show of poor Mathews' mutilated limb, whilst yet its living effect upon the laughing stage had departed from the general gaze only a few brief hours, was, we think, in very bad taste, and very inconsistent with the decent observance of respect for the dead."

The development of Swift's skull was extraordinary, and much at issue with his known character. The phrenologists explained this to proceed from disease!

STATISTICS.

Rev. Mr. Stanley, President.

Dr. Maunsell read a paper on the Foundling Hospital of Dublin, and the general effect of Institution for deserted children. The charge of excessive mortality brought against this hospital, appears from Dr. M.'s statement to be unfounded. Dr. M. strenuously recommended the system of educating the children in the country rather than in the hospitals, and mentioned some curious anecdotes of the ties that attach the foundlings to their nurses. In fact, they become, in most instances, the children, by adoption, of the peasants to whom they are entrusted, and the adopted parents treat them as if they were their own offspring. The tables appended to this report, seemed to contradict the theory that more males are born than females, but Dr. Maunsell accounted for this discrepancy, by showing that boys are regarded in the lower ranks of life as a source of profit, while girls entail expense; and, therefore, males are less frequently exposed than females.

Mr. Langton read a report on the state of Education in Manchester, which presented this general result, that while in Prussia, and several of the German states, all children of every class, between the ages of seven and fourteen, are obliged by law to attend school, and it is shown by statistical returns, that they actually do so, there are in Manchester, not quite two-thirds of those between the ages of five and fifteen who receive even nominal instruction.

Several valuable tables were appended to this report, which confirmed all its statements.

The *Rev. Dr. Dickinson* said, that the subject of educating masters had engaged the anxious attention of those who presided over the institutions for public instruction in Ireland. It had been practised on a limited scale with the best effect, by the Kildare-street Society, and the Association for discountenancing Vice. The Board of Education recently established, had also taken a large establishment, in which it was proposed to educate four hundred teachers, for the use of their schools.

The *Rev. E. G. Stanley* said, that he had recently made a tour in the west of Ireland, and could bear personal testimony to the great anxiety felt by the Irish, for the spread of education. He had gone into many of their schools, and had always been received unsuspiciously and kindly. In general he found the quantity and quality of instruction above the common average of England.

A paper was read by *Mr. W. R. Gregg* on the State of Crime and Prison Discipline in the Netherlands; and another by *Dr. Cleland*, on the System of Management followed in the Glasgow Bridewell. "Much," said Dr. Cleland, in conclusion, "has been said about classification, and latterly an experiment on the silent system has been introduced into some of the English Houses of Correction, and, probably, with good effect, where the formation of the prison does not admit of solitary confinement; but I am firmly of opinion that no classification nor silent system, however well managed, can be equal to solitary confinement."

Mr. Halswell related some curious facts to prove that really solitary confinement, including exclusion from the light, was of such a nature that no man could endure it for

more than ten days. He would recommend in place of it separate confinement, by which contamination might be prevented.

[In the preceding abstract of the proceedings of the different Sections, we have noticed those papers and communications only which are likely to be of interest to our readers.]

GENERAL OBSERVATIONS.

(From the *Athenæum.*)

The meeting of the Association is over; but before we proceed to draw up a record of its proceedings, we must say a few words on the general results of the week, and the impression left on our minds. On former occasions, hospitality has been shown by the residents of the place of assemblage to the wayfaring visitors, and the business has preserved the "even tenor of its way;" but in Dublin, notwithstanding the unusual quantity and quality of the scientific communications, business has been positively perplexed by the joyousness and festivities of the occasion. The Irish are a fine, generous, and hospitable people: on the first word of an approaching avatar of science on the shores of the Green Island, they set themselves seriously to work, to contrive how they might best do the honours by the distinguished associates whom they expected, and by themselves and the country they represented. To do them justice, they neither spared money nor trouble to please and accommodate their guests, and to prove that, as far as concerns the respect for science, and the *savoir vivre*—

Non tam aversus equos *Tyriæ* sol jungit ab urbe.

(Every body knows the applicability of this local epithet, and the Phœnician cradle of the Hibernian people.) In all these respects they succeeded, *usque ad delicias votorum.* Every practicable accommodation has been afforded for the lodging, feeding, feasting, and amusing of the strangers; and the visitors are, at this very moment, packing up their carpet bags, in high good humour, and "shut up in measureless content." Déjeuners, dinners, rural excursions, public entertainments by the learned bodies, and private parties by individuals of distinction, have exhausted all their combinations, to scatter the flowers of sociality over the path of scientific labour; and if many go away not much the wiser for their journey, there can be but few who will not depart full of pleasant recollections.

In the mean time, a question arises concerning the permanent interests of the Institution — and "there's the rub." Setting aside the distraction of mind incidental to the crowding together so much business (for pleasure as well as science has been made a business), the vast numbers of all classes and pretensions who have joined the Association, and flocked to its halls, cannot but have disturbed the march of the proceedings. Imagine the Rotunda,—a room capable of accommodating from 1500 to 2000 individuals,—thronged to excess on some of the hottest evenings of this hot and cometary season: the ladies flirting and fanning; the gentlemen casting one eye upon Science and another upon Beauty; and the whole (saving the reader's presence) moping, and puffing, and ready to drop with exhaustion and fatigue. Then reflect on the sort of attention which those in earnest about the business in hand could give to the discourses of the orators. First, they were fatigued with the labours of the Sections; then trotted about the city to see sights and walk off the repletion of the copious and elegant breakfast which preceded them;—then came the hot and crowded ordinaries, with hundreds seated round the smoking viands; and finally hurried off to encounter the jostlings and the stewing of the evening meeting. But the business of the day was not even then concluded, for the rout and the supper had yet to be gone through; and the next morning, with bodies jaded by the labours of the previous day, and minds still clouded with the yesterday's feast, the itinerant *savans* had again to brace themselves for encountering the like routine. Even in the Sections themselves, the scientific were not left in peace; both sexes were eager to attend them; and the ladies, as they could not be in the whole at once, made the best they could of their case, by crowding in shoals to that particular Section where the business was of the most abstract and recondite description. These inconveniences were not perhaps very seriously felt at the moment; amusement and gratitude disarmed criticism; but the truth will, we fear, soon start into evidence, that the Irish meeting has been, all things considered, rather too splendid an affair. Again, will not all this expense, show, and excitement, throw cold water on the meetings of future years? Many will grudge a costly and troublesome journey that is to end in a junketing; and those for whom the pleasure has had its charm, can hardly expect to see the *éclat* and splendour of the Dublin meeting maintained hereafter. Heaven help the people of Bristol, whose turn comes next! In a city which is nothing but commercial, with no university, no learned and scientific corporations to keep up the ball, not all the turtle in their next fleets can vivify their proceedings. On the whole, then, we cannot but fear that the pleasure has been over-done; that the Association has been killed with kindness; and that the institution will feel the *ricochet* of this hot fit of delight. But so far as Dublin itself is concerned, the success, it must be admitted, as been complete.

ON RAILWAYS. BY JOHN HERAPATH, ESQ.

NO. IX.

Calculation of the Expense and Time of Transit on ascending and descending Planes.

My third Number contains rules for computing the time, velocity, &c., of transit, with a table, calculated for any rising inclination not exceeding 60 feet per mile. There is little difficulty, indeed, in computing for ascending planes, but for descending it is no easy matter to determine the limits of descent in which the steam can be fully applied, and those in which it must be partly cut off, with the amount of partial application. We must here, I imagine, be guided by considerations of safety. If 30 miles an hour be the ratio on a level, the question is, at what rate can we safely run down a slight descent? Can we venture 40 miles an hour? If we can, probably this would be the outside with our present engines. Hereafter, we may possibly go at a greater rate, but at present it would be hazardous. Now, full steam applied to a fall of 5¼ feet per mile, would, by our theorems, in No. 3, give a velocity of 40 miles an hour. If, therefore, we take, in order to have round numbers, 6 feet per mile as the maximum descent at which full steam can be applied, which makes the velocity 41¼ miles per hour, we shall be able to devise a very easy mode of calculating the time and expense of transit for any length of time, whatever be its rate of practicable ascent, if neither of its descents exceeds 6 feet per mile. For since $\frac{30}{1 \pm \frac{h}{22}}$ miles : 60 minutes :: 1 mile : $2 \pm \frac{h}{11}$ minutes, the time in which 1 mile would be run, h being the ascent or descent per mile in feet; therefore, if m be the length of the plane in miles,

$$2m \pm \frac{mh}{11}$$

is the time of transit in minutes, in which mh is the whole height or fall of the plane. Consequently, if there be a series of such planes, M being the total length of them in miles, and H the sum of all the heights in feet minus all the falls, or the difference in elevation of the extreme points, the time of transit is in

$$\text{minutes} = 2\,M \pm \frac{H}{11} \ldots (5)$$

in which the plus sign holds when the latter extremity is higher than the former, and the minus when it is lower.

This theorem, which is much more accurate than the table in No. 3, is perhaps the simplest that can be given within the limits for which it has been investigated.

The expense, too, of transporting a ton of goods, which bears a given ratio to the time, other things alike, is had by simply multiplying (5) by the expense per ton per mile. If a halfpenny be the latter cost, then the expense per ton in pence for the whole distance is

$$M \pm \frac{\frac{1}{2} H}{11} \ldots\ldots\ldots (6)$$

These theorems, as we have said before, apply for all practicable rises, combined with such descents only as do not exceed six feet per mile; where the descents are greater, other methods must be had recourse to. In comparing the southern lines in No. 4, I have considered all descents to be run at a velocity of 30 miles an hour, and at a cost of a farthing per ton per mile. As a matter of comparison this may do nearly, both lines being subjected to the same rule; but it is evidently only a rough approximation as regards any one line. Indeed, taking descents generally between 0 and the fall beyond which gravity would do all the work, that is 22 feet per mile, I know of no correct rule for estimating either the expense or time of transit, nor, perhaps, can any be given. We are left entirely to our own judgment, unassisted by experience, and in a case in which it would be unsafe to apply theory beyond certain limits. The following views, therefore, are presented merely to fill up a blank, until experience shall furnish us with something better.

It is generally admitted, that the more level a line is, the greater is the velocity which can be run in safety; and that the steeper the descent, the less must be that velocity. Hence it is on

the Liverpool and Manchester Railway, that the Directors impose severe penalties on the men if they allow the trains to descend the two principal inclined planes, whose mean fall is about 58 feet per mile, at a greater velocity than 24 miles an hour; though down the easier planes, and on levels, velocities of 35 miles or more an hour are often attained, and I believe permitted, because they are not considered dangerous. Now, if starting from our fall of six feet a mile, at which the velocity, with full steam on is about 41¼ miles per hour, or a mile in 1 minute 27 seconds, we gradually diminish the velocity by increasing the time of transit, at the rate of one second a mile for every extra foot of fall in a mile, we shall at 58 feet fall per mile have a speed of one mile in 2 minutes 12 seconds, or 26 miles an hour. This, therefore, gives a scope for improvement on the Liverpool line of about two miles per hour on their two inclined planes. To what greater length this progressive increase of time may be carried is difficult to determine, possibly to a fall of at least double the rate of descent; but as it is to be hoped no railway for passengers will ever again be constructed with such planes, we need not, perhaps, trouble ourselves to inquire into the extent of application.

On these principles, the time of transit down planes descending more than six feet per mile, is likewise easily calculated. It is only multiplying the length of each descending plane in miles by 1 minute 27 seconds first augmented by as many seconds as the fall per mile exceeds six feet, and the sum of the times will be the time of descending all the planes.

In regard to the expense of fuel, it appears to me, if the descent of any one plane does not exceed ten or twelve minutes of time, that is, five or six miles of length, little or nothing can be saved though all the steam be turned off; for, if the fire be not kept up, and the temperature of the water be allowed to sink, the engine will not be prepared for working the subsequent rise or level. Therefore, supposing as before the consumption of fuel to bear a constant ratio to the time, the expense of transporting a ton of goods is in pence found by taking ⅛ of the whole time of transit in minutes, or by multiplying the minutes of transit by such a decimal of a penny as the cost on a level actually is, whatever be the inclinations, if no one descent exceeds a run of about ten or twelve minutes, or a length of about five or six miles.

Though the expense of transit for fuel is considerable, it would appear, from the Liverpool and Manchester half-yearly Reports, that the expense amounts to not more than a fourth or a fifth of the actual cost for locomotion. The men's wages for repairing, and the materials used for the repairs of the engines, &c., often exceed each the cost of fuel. This certainly argues very much against the present state of our machinery, and of the locomotive power on the Liverpool and Manchester line, and tells us, in no equivocal language, that the field for improvement is hitherto but little cultivated. On the face of it, we should say, if the machinery was in any but a most imperfect state, so great a disproportion could not exist between the aliment of motion and the mere wear and tear. I beg to observe I do not state this complainingly, but as a simple fact, and as a fact to stimulate our aspiring mechanics to bend more intensely their minds on the improvement of this valuable instrument. One of the most important steps towards the perfection of locomotive engines hitherto made, is that of sending the hot air and flame through the numerous small tubes traversing the water in the interior of the boiler. This improvement, I believe, is due to the suggestion of Mr. Booth, of the Liverpool and Manchester Railway. Without some such contrivance for increasing vaporization, the power of the engine would have been still exceedingly feeble. The first tubes were three inches diameter, and they are now, I believe, reduced to under an inch. If they could be still further diminished in diameter, and increased in number, it would contribute much more to the steam-generating power of the engine; while, I apprehend, it would greatly lessen the burning out of these tubes, and, consequently, the excessive expense of repairs. For, as the thickness of the tubes may be diminished in proportion to the diameter, if the diameters were, by way

of example, reduced one half, and their thickness in proportion, the temperature of the heated air or flame passing through the tubes would be communicated to the water, and, conversely, the temperature of the water to the interior of the tube, in one half the time, or with double rapidity. Consequently the temperature of the interior surface of the tubes will always be kept nearer that of the water, that is, much lower than with thicker tubes, and the exfoliation of the tubes by the blast, or the burning out of them, therefore diminished; for the nearer the temperature of the tubes can be reduced to that of the water the better. If it was possible to keep them to the same temperature, they would, perhaps, hardly ever burn out. Besides, by diminishing the diameter to a half, we must quadruple the number of tubes, in order to carry off the same draught. This would double the heating and heated surface; and therefore, in my opinion, further diminish the exfoliating power of the fire by spreading its influence over a greater surface. Limits, however, must be set to this reduction of diameter. If the tubes were too small, they would be in danger of being choked by the particles of coke driven into them by the strong draught through the fire. Again, there would be a great inconvenience in the number of them. For instance, if the diameters were reduced one half, and the number of tubes quadrupled, at length, by going on in this way, we should fill the boiler entirely with tubes, or have them so thick as to have nothing but one mass of steam among them, particularly towards the fire-box end, by which most serious accidents might be engendered. However, it is well worth the while of mechanics to try to find the minimum diameters to which the tubes can be efficiently reduced. It is purely an experimental subject, and I have no doubt would well reward the labour of inquiry.

It once occurred to me, that if the tubes were conical instead of cylindrical, it might be advantageous; but on more mature consideration I do not think it possibly could. Supposing they were conical, and that the less ends were towards the fire-box, their thicknesses gradually increasing with their diameters; then, though we should gain all that we have previously described with respect to reducing the diameter and thickness of the tubes, yet if the velocity of the hot air through the tubes bore any sensible ratio to the velocity with which such air transmits heat, that is, to the velocity with which the said air so heated would conduct sound, there would be a very serious loss of temperature by the expansion of the air, owing to the enlargement of the tubes as it passed through them. And, if the large ends of the cylinders were next the fire-box, though it may be the best possible arrangement—and we should certainly gain much where we before lost—yet, in practice, it may be attended with great inconvenience, from the disposition of the tubes to choke. The chief defect in the present locomotive boilers, is, in my opinion, the having of the fires at one end, and the want of a more equal distribution of heat through the water. A boiler, a description of which I have lately seen, invented by Mr. Joseph Gibbs, one of our civil engineers, appears to me to be grounded on good philosophical principles; but how it would answer in practice I am unable to say, never having seen it in work. His principle is to have the fire-box not far beneath the surface of the water, and to send the heated air in a spiral tube downwards towards the bottom, about which the jet of cold water is introduced. But enough of this subject; I have now not time to go into it.

I am glad to find that since the publication of my observations on the excessive expense of carrying private Bills through Parliament, the subject has been taken up in the House; and I have again since heard it is intended to be brought forward next Session, and supported by several influential Members. I shall recur to it shortly. But it is not on the subject of Parliamentary expense only the public feeling wants to be roused; there are others of deep importance, which need to be brought before them. I hope I shall not presently be goaded to lay bare a scene of injustice, jobbing, and base trickery, that will make knaves themselves stare, and honest men shudder.

JOHN HERAPATH.

Kensington, August, 1835.

Dear Sir,—I enclose some papers relative to Halley's Comet, which I originally intended to keep for my own private use, but considering that they may be of more extensive utility were they to find a place in your valuable Magazine, I send them to you for publication.*

The path of the comet is taken, with a few corrections, from the *Nautical Almanac*.

I remain, dear Sir,
Yours truly,
E. HENDERSON.

Pall Mall, London, August 22, 1835.

Table of the Right Ascension, Declination, Meridian (London) Altitude, and Meridional Passage of Halley's Comet of $75\frac{1}{2}$ *years.*

	Right Ascension.		Declination.		Meridian Altitude.		Meridian Passage, Astronomical Time.	
August, 1835.	h.	m.	°	′	°	′	h.	m.
1	5	20	22	19	61	9	20	11
8	5	29	23	4	61	53	20	25
15	5	35	23	47	62	27	19	59
22	5	41	24	39	63	11	19	37
31	5	51	26	3	64	41	19	13
September								
1	5	52	26	5	66	52	19	11
8	6	1	27	56	66	52	18	52
15	6	14	30	53	70	25	18	34
22	6	34	34	57	79	13	18	33
30	7	53	44	52	83	51	19	17
October								
1	8	37	49	7	84	57	20	23
5	12	41	51	53	89	38	23	45
8	13	33	50	49	71	17	1	50
14	16	3	10	22	50	3	1	57
18	16	11	0	35	41	57	2	21
22	16	33	4	58	33	52	2	37
31	16	45	11	6	29	2	2	3
November								
1	16	44	12	2	27	42	2	1
8	16	41	14	49	24	11	1	34
19	16	36	16	51	20	37	0	40
23	16	29	18	23	19	24	0	21
27	16	21	20	11	18	59	0	7
December								
1	16	20	20	16	17	51	23	36
8	16	11	21	33	16	49	22	59
15	16	5	22	17	14	53	22	31
22	16	1	23	47	13	23	22	1
31	15	52	25	3	13	9	21	6
January, 1836,								
1	15	47	25	17	12	56	21	3
8	15	43	26	13	12	11	20	31
22	15	24	28	44	9	51	19	14
31	15	3	29	59	9	17	18	17
February								
1	14	59	30	6	8	56	18	11
8	14	37	31	11	7	11	17	27
15	14	9	32	1	6	39	16	53

* One of the papers thus obligingly sent to us is a very accurate projection of the orbit of the comet and the part of the heavens through which it passes. We thought we should have been able to get this engraved in time for our present number; but as we find this to be impracticable, and the information contained in the other papers would suffer from delay, we must refer the reader, who may require the aid of a chart in his observations, to that given in the *Nautical Almanac*, or to the copy of it in the Companion to the Almanac for 1835.

Example.—On August 1, 1835, the comet had $5^{h.}$ $20^{m.}$ of right ascension, 22° $19^{m.}$ of declination, N., 61° $9^{m.}$ of meridian altitude, and its meridian passage was $20^{h.}$ $11^{m.}$ 31st day of July. The astronomical day begins when the sun is on the meridian, or just 12 o'clock; reckoning $20^{h.}$ $11^{m.}$ forward, will make out August 1, at $8^{h.}$ $11^{m.}$ A. M.; consequently, the comet must have risen somewhere about midnight, and set somewhere about 4 o'clock afternoon, of the 31st day of July.

Remarks.

The present comet is supposed to be the same that appeared in the years 1005, 1080, 1155, 1230, 1304, 1380, 1456, 1531, 1607, 1682, and, as predicted by Halley from the equality of the intervals between these appearances and from calculation, again in 1758. The year 1005 being subtracted from the present year, leaves an interval of time equal to 830 years, during which time it must have accomplished 11 revolutions; therefore, $830 \div 11 = 75\frac{5}{11}$, or 75½ years for the mean revolution. For short periods of time the period of the comet lengthens; thus, from 1005 to 1835, the average period, as has been stated, amounts to $75\frac{5}{11}$ years, or, decimally, 75·454 years; while from 1080 to 1835, a period of 755, including 10 revolutions of the comet, the average period is 75½ years. All its average rates of revolution are as under:—

1005—1835	÷ 11	= 75	years	·454
1880—1835	÷ 10	= 75	—	·500
1155—1835	÷ 9	= 75	—	·555
1230—1835	÷ 8	= 75	—	·625
1304—1835	÷ 7	= 75	—	·857
1380—1835	÷ 6	= 75	—	·833
1456—1835	÷ 5	= 75	—	·800
1531—1835	÷ 4	= 76	—	·000
1607—1835	÷ 3	= 76	—	·000
1682—1835	÷ 2	= 76	—	·000
1759—1835	÷ 1	= 76	—	·000
		833	·	624 years.

Daily velocity of the comet in its orbit from 1st August to 13th September, about 2 millions of miles; from the 13th September to 1st October, about 3 millions of miles; from 1st to 8th October, about 3½ millions; from this period to 1st November (average) 2½ millions of miles, &c. &c.

833·624 years ÷ 11 = 75·784 years mean average period of Halley's comet, or about 27,678 days.

On or about the 1st of August the comet was about 250 millions of miles distant from the earth.

About the 1st of September its distance will be within 125 millions of miles; it will rise about midnight in the N. E., and will then be visible till the dawn of day in the eastern heavens.

On or about the 3rd of October, the comet will be only about 42 millions of miles from the earth, and will be seen entering the fore-foot of Ursa Major, or the Great Bear; this will be the period of its greatest brilliancy and magnitude. About the 8th of October it will approach nearest the earth, being within 28 millions of miles.

The nearest approach of the comet to the earth will be between the 7th and 8th of October; but it will not reach its parhelion till the 17th of November, or about 40 days after its nearest approach to the earth, which is a matter of some regret; for had the comet been in its parhelion, and at its least distance from the earth, at the same time, a much more magnificent sight of cometary phenomena would have presented itself to our view.

On the 17th of November it will be about entering the sign Gemini, and its distance from the earth will be about 90 millions of miles. The tail will then increase in brilliancy and magnitude. The comet will now rise earlier and earlier every succeeding evening; and its motion be very rapid. About the 20th of November, the comet will lose itself in the Sun's rays, and will be invisible till about the 27th of December, when it will again re-appear at the distance of about 230 millions of miles. Once more it will approach the earth, and will remain visible till about either the 7th

or 15th of February, when it will lose itself in the voids of space, near the largest star of Centauri, in right ascension 14°. 9'., and in declination 32°. 1'. south.

Note.—The same comet was in its perihelion about the 12th of March, 1759, and having reached the same point about the 17th of November, 1835, this shows the time which it has taken to enjoy itself in its last circuit round the Sun to be about 76 years, 8 months—a much greater length of time than it has hitherto employed. It may be inferred from the analysis given of its various periods, that its period is on the increase; but as the precise days of its entry into its perihelion, on each of its recorded appearances, has not been given, this cannot be positively determined.

The comet was seen at Rome about six days ago; and it is reported to have been visible in England on Thursday evening, the 20th of August.

E. H.

Notices of the Appearance of the Comet.

Observatory of the Collegio Romano, Rome, Aug. 6.—Yesterday, at about half past 7 (Roman time), Halley's comet was seen from here, at that part of the heavens calculated by Damoiseau. Its light was very faint, much resembling that of Biela's comet. It is near the star Zeta, in Taurus. Its right ascension we found to be 5°. 26'.; and its north declension, 22°. 17'.—*Algmeine Zeitung.*

Observatory, Kensington, Sunday Morning (23d Aug.) 4 o'clock.—Having cautiously examined that portion of the heavens between 4 hours, 50 min. and 6 hours, 30 min. of right ascension, and 30 and 24°. north declension, I found in the field of the telescope, at 1h. 11m., sidereal time, a round, well-defined nebulous body, hitherto undiscovered, extremely faint, and perhaps about 2m. of space in diameter.—*James South, Times,* 24th August.

Ditto, Monday Morning, 4 A.M.—The nebulous body *is* Halley's comet. At 23h. 55m. and 47s., sidereal time, this morning, its right ascension was about 5h. 43m. and 8s.; whilst its northern declination was 23°. 49m. 43s.—*James South. Ibid.*

Rectory, Hayes, Kent.—Seen here by Dr. Hussey on the nights of Saturday and Sunday (22d and 23d of August), who, in a note to the *Times,* says:—"The approximate place is right ascension 5h. 42m. 30s., declination north 23°. 45m. 20s.; is very large, and in an achromatic telescope of 6·5 inches aperture, it is the faintest object the eye can distinguish."—Mr. Lubbock states, in a note to the same journal, "That the place assigned to the comet in the ephemeris published in the *Nautical Almanac* for 1835, Aug. 23, is 5h. 42m. 56s. right ascension; declination, 25°. 21m. 1s. A closer agreement could not have been hoped for."

THE AMERICAN "FASTEST SHIP IN THE WORLD."

Sir,—I have read an extract from an American paper, in your last Number, p. 384, giving an account of the trial of the Lexington steamer. I do not quite understand the construction of her deck; and should be glad to receive further information by a sketch in your Magazine. Neither do I comprehend how she could move at the rate of 20 miles an hour, seeing the greatest velocity of her paddle-wheels is but 19·7064 per hour. Perhaps your printer made the error, in stating the diameter of the wheel at 24 feet; surely it should have been 34 or 42 feet: it is in vain to expect an engine with a stroke of 11 feet to make more than 23 per minute; indeed, this speed for the piston is greater by far than is usual in England; so that the speed of the vessel must be attained by increasing the diameter of the wheel.

Under this idea, I do hope your correspondent will write for a more detailed account of the Lexington and her engines, for at present she looks a "trifle slanting-dicular." At the same time, I am ready to acquit your correspondent of any personal intention of misleading your readers.

I am, Sir,

Yours truly,

W. Thorold.

Norwich, August 22, 1835.

Sir,—Having read in your valuable Journal for August 15th, an account of the "fastest boat in the world," I was induced to look minutely into the description given; and upon comparing the diameter of the wheel with the number of strokes mentioned, I find that the speed of the boat (which is stated to be twenty miles per hour) is two miles an hour faster than the motion of the periphery of the wheel!

Now, Mr Editor, I take upon myself to say, that no steamer in this country has approached within some miles, the speed of the diameter of the wheels. The "Diamond," "City of Canterbury," and "Star," now running in the Thames, are no doubt the three fastest boats in Europe; the speed of these boats, is as near as possible, thirteen geographical miles per hour, during which time the periphery of the paddle-wheels moved seventeen miles, travelling four miles per hour faster than the vessel.

Now in the description of the "fastest boats in the world," the diameter of the wheel is given at twenty-four feet, and the speed twenty-one to twenty-three strokes per minute; I have taken the mean of twenty-two strokes per minute; this gives, for the speed of the wheels, eighteen miles per hour, and deducting four miles, as is the case with the three boats before mentioned, will leave fourteen miles per hour; but I will not allow the Americans even this speed, for two reasons; first, it will be observed, that I have founded my previous observations upon three of the fastest, as well, perhaps, as the best boats in this country, both as regards engines and construction, which is the reason that the speed of these boats approaches so near the speed of the wheels; for if the average of thirty boats on the Thames be taken, we shall find that the wheels are often going fifteen miles an hour, while the boats are going only ten miles. Again, the lumber, which is used in American boats, and called steam engines, can never be compared with the engines as now manufactured by our first-rate makers, either for lightness, safety, or effective force. Taking all these facts into consideration—facts which are well known to scientific men in this country—I think we may allow the American boats a speed approaching thirteen miles an hour, and not more; and this speed is not produced by the eleven-feet stroke or the arched deck and beams, but from the simple fact of her enormous length, as compared with her beams. Vessels of this class may do very well for the large rivers of America, but never would do for sea service, or for the rivers of this country.

As I find in your last number, *another American* has been giving his countrymen a fillip, by endeavouring "to explain more clearly than your former correspondent has done, why this boat has attained this wonderful speed," but which explanation only shews the manner in which she is trussed longitudinally; perhaps he will now have the goodness to explain, why in America steam ships go *faster than their wheels*, while in all other countries they generally go from one third to one fourth slower.

I am, Mr. Editor,
Your obedient servant,
FANQUI.

NOTES AND NOTICES.

Dear and Bad.—It is stated by Colquhoun, that "the chief consumption of oysters, crabs, lobsters, pickled salmon, &c., when first *in season*, is by the lowest classes of the people. The middle ranks, and those immediately under them, abstain generally from such indulgences, until the prices are moderate." This abstinence of the middle classes may be also ascribed to their better information; knowing that when provisions are *highest* in *price*, they are the *worst* in *quality*.—*History of the Middle and Working Classes, Second Edition.*

The Great Western Railway.—The Lords' Committee, after an inquiry of forty-six days, have come to a decision in favour of the Bill for this railway. There was a majority of twelve in favour of the undertaking. Such was the interest excited, that more than seventy of their lordships attended the Committee and voted.

"A Jurat" informs us, that the new Pier, Gravesend, "presents the rare spectacle of a public work of great difficulty executed within the architect's estimate." We are glad, but not surprised, to hear it. The architect is Mr. Tierney Clarke, who built the Hammersmith Suspension Bridge, which also was erected for some 200*l.* or 300*l.* less than the estimated cost.

We invite the attention of Mr. Barstow, and of Americans in general, to the letters in our present Number of Mr. Thorold and Fanqui, respecting the "Fastest Vessel in the World."

R. M. M. has been misinformed. When engravings are necessary for the illustration of articles of "public interest," it is not our practice (whatever may be the practice of others) to charge the authors with the expense of them. We are at all times very willing to be at such expense; and the more extensively this is known, shall be the better pleased.

W.'s valuable paper on Indigo, in our next.

Communications received from Mr. Milbourne—T. C.—Mr. Davy—A Subscriber and Admirer—P. A. M.—T——s H——d—Alongshoreman—Steam Serpent—Major Longbow—A Young Apprentice (who will find at the next P. O. a letter addressed to him).

LIST OF NEW PATENTS, GRANTED BETWEEN THE 22D OF JUNE, AND 22D OF JULY, 1835.

Henry Bernard Chaussenot, of Leicester-square, civil engineer, for an improved construction of the lamps or apparatus used for burning gas for producing a better combustion of the gas. July 28; six months to specify.

Spole Rosenborgh Anderson, of Cornhill, Esq., for improvements in hand and power looms. July 28; six months to specify.

Robert and Alfred Charlton, of Manchester, calenderers and finishers, for certain improvements in the machinery used for stiffening and finishing woven or manufactured goods. July 28; six months to specify.

William Crofts, of New Radford, county of Nottingham, machine-maker, for certain improvements in certain machinery for making figured or ornamented bobbin net, or which is commonly called ornamented bobbin net lace, and which improvements are in part in extension of part of the improvements for which Letters Patent were granted to him on the 23rd day of December, 1834. July 30; six months to specify.

William Mason, of Brecknock-terrace, Camden town, county of Middlesex, engineer, for improvements in the manufacture of fire arms and artillery. August 6; six months to specify.

William Mason, of Brecknock-terrace, Camden-town, county of Middlesex, engineer, for improvements in the manufacture of steam-engine cylinders, pistons, bearings, pumps, and cocks. August 6; six months to specify.

Samuel Faulkner, of Manchester, cotton-spinner, for an improvement in the construction of a machine for carding cotton and other fibrous substances. August 6; two months to specify.

John Cooper Douglas, of Great Ormond-street, county of Middlesex, esq., for certain improvements in ventilating subterraneous and other places, and in constructing an apparatus or apparatuses in which combustion is carried on, and also in applying certain fluids to various useful purposes, and in constructing an apparatus or vessel for the appropriation of such fluids. August 10; six months to specify.

Edward Jones, of Birmingham, builder and brickmaker, for certain improvements in machinery for moulding bricks, tiles, and other articles made of brick earth. August 10; six months to specify.

Samuel Wilson Nicholl, of Elham, near Canterbury, gentleman, for certain improvements in rendering condensing steam-engines portable and applicable as a means of general transport on rail and other roads. August 10; six months to specify.

Luke Hebert, of Paternoster-row, London, civil engineer, for certain improvements in flour mills. August 10; six months to specify.

William Evatt Wright, of Regent-street, Westminster, gentleman, for an improved box for holding coals. August 12; six months to specify.

John Day, of York-terrace, Peckham, gentleman, for an improved wheel for carriages of different descriptions. August 14; six months to specify.

Richard Sheppard, of Newport Pagnell, carpenter and builder, for improvements in tiles for covering of roofs. August 17; two months to specify.

Thomas Rock Shute, of Watford, silk throwster, for improvements in spinning and doubling organzine silk. August 17; six months to specify.

Frederick Bowman, of Great Alie-street, county of Middlesex, sugar-refiner, for an improvement in the process of renewing the virtues of animal charcoal when exhausted or impaired, being a communication from a foreigner residing abroad. August 17; six months to specify.

Henry Phillips, of Exeter, chemist, for certain improvements in purifying gas for the purpose of illumination. August 17; six months to specify.

William Banks, of Spring-hill Terrace, near Birmingham, manufacturer, for a certain improvement in machinery pens and presses for ruling and pressing paper. August 17; two months to specify.

Henry Pinkus, late of Pennsylvania, in the United States of America, but now of 76, Oxford-street, Middlesex, gentleman, for improvements in inland transit; which improvements are applicable to, and may be combined with, an improved method of, or combination of method and apparatus for communicating and transmitting, or extending motive power by means whereof carriages or waggons may be propelled on railways or roads, and vessels may be propelled on canals, for which improved methods, &c., Letters Patent were granted to the said Henry Pinkus, dated the 1st day of March, 1834. August 17; six months to specify.

Elijah Galloway, of Wellington-terrace, Waterloo-road, county of Surrey, for certain improvements in paddle-wheels for propelling vessels. August 18, six months to specify.

William Johnson, of the Horsley Iron-Works, county of Stafford, gentleman, for a certain improvement or certain improvements in the construction of boots and shoes. August 22; six months to specify.

William Lucy, of Birmingham, miller, for certain improvements in steam-engines. August 24; six months to specify.

Theodor Schwartz, technologist, formerly of Stockholm, but now of Bradford-street, Birmingham, for a practical application or practical applications of known principles to produce mechanical power. August 24; six months to specify.

Charles Appleby, of Sheffield, merchant, for certain improvements in manufacturing files. August 25; six months to specify.

John Lane Higgins, of Oxford-street, Middlesex, Esq., for certain improvements in the construction of and in working vessels for navigation. August 26; six months to specify.

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MUSEUM, REGISTER, JOURNAL, AND GAZETTE.

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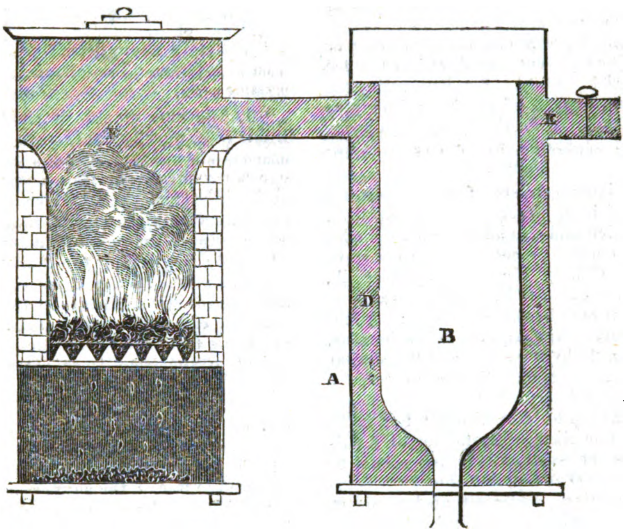
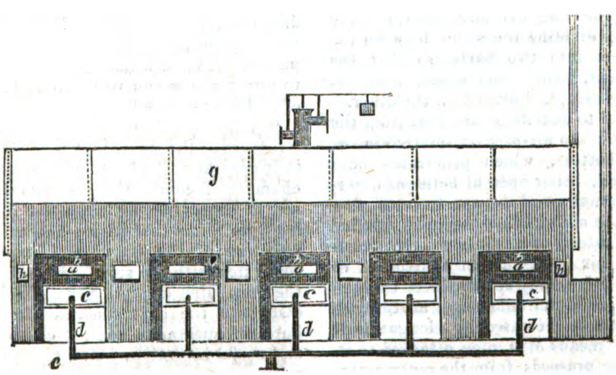
OLMSTED'S STOVE.



CLUTE'S BOILER.



OLMSTED'S STOVE FOR BURNING ANTHRACITE (WELCH COAL)

The first figure on the preceding page represents a section of a stove for burning anthracite or Welch coal, which has been patented by Denison Olmsted, of New-haven, Connecticut, and is thus described in the inventor's specification, published in the *Franklin Journal* for June last:—

" For generating the heat, I employ an anthracite coal stove, of ordinary construction, so far as relates to the chamber of combustion; but I prefer one made of sheet or cast iron (I at present use sheet-iron), lined with fire-brick, or lute. For distributing the heat, I use, instead of the open iron pipe generally employed for that purpose, a peculiar kind of apparatus, which I call a radiator, constructed as follows:—

" A radiator consists of two concentric cylinders of iron, either sheet or cast iron, between which and around the inner cylinder the heated current proceeding from the stove circulates. Calling the outer cylinder A, and the inner cylinder B, their connexion or arrangement may be thus described:—A, being a cylinder of any required dimensions (as, for example, 24 by 9 inches), and B a similar cylinder, but of smaller dimensions (as, for example, 21 by 5 inches), the two are placed upright; the top of B is brought to a level, or in the same plane, with the top of A (although it is not essential that they should be in the same level at top, but this is the common construction), being situated within it, and concentric with it, and reaching to within a few inches of the bottom of A. The inner cylinder B is closed at bottom, but open at top. The circular ring, or space, between the two cylinders at top is closed, and a partition is inserted up and down on opposite sides of the inner cylinder, and the whole length of it, dividing the space between the two cylinders into two parts, so that the heated current, before mentioned, may descend on one side, and ascend on the other.

" In order to distribute the heat from the inner cylinder, an air-pipe is inserted in, or near, the bottom, which penetrates both cylinders, and, being open at both ends, permits the internal air of the apartment to flow into B, as the air within B becomes rarefied by heat. Instead of the air of the apartment, fresh air from another apartment, or from out of doors, may be introduced through the air-pipe, or the circulation of air through this pipe may be increased by elongating B upwards, by means of a pipe attached to it. A smoke pipe proceeds from the outer cylinder A, near the top, which communicates either directly or indirectly with the chimney.

" The radiator thus constructed being connected with the stove before described, by a short pipe (the stove and the radiator usually stand side by side), the heated current, when the stove is in action, passes through this pipe into the radiator, descends between the two cylinders, flows into the inner cylinder B, ascends on the other side, and passes out at the smoke-pipe, near the top of the radiator.

" In order to remove such ashes as may be deposited from the heated current on the bottom of the outer cylinder A, a small opening, closed by a door, or plate, is made in or near the bottom of A.

" The stove above described is susceptible of various forms. The following are given as examples, viz.

" 1. We may employ a single radiator. In this case, we may either have smoke-pipes attached to both the stove and the radiator, each being furnished with a damper to regulate, or to exclude, the draft; or we may have but one smoke-pipe, namely, that communicating between the radiator and the chimney.

" 2. We may employ two radiators, one on each side of the stove. From each radiator, and from the stove, pipes enter the flue of the chimney, either directly or indirectly, each pipe being furnished with a damper. A convenient arrangement is to place the whole apparatus, namely, the stove and radiator, or radiators, parallel to the breast of the chimney, on the hearth, for example; and the fire-place being closed, to let the three pipes enter by apertures, left so as to form an opening into the flue of the chimney.

" 3. Where the communication with the flue of the chimney is made by means of a long smoke-pipe, the smoke-pipes from the radiators may be made to enter this pipe behind the damper, instead of entering directly into the flue of the chimney.

" What I claim as new in the stove just described, is the use of a drum or drums of peculiar construction, so combined with the part of the stove which generates the heat as to afford a new and very advantageous mode of distributing the heat.

" I do not claim any thing new in the structure of the stove, that is to say, the part that generates the heat, otherwise called the chamber of combustion; nor do I claim the use of concentric cylinders for distributing heat, as a new invention; but this peculiar structure of the drum, and its immediate connexion with the stove, as a substitute for the open pipe or pipes usually employed to distribute the heat generated in stoves for burning anthracite coal, I claim as a new and useful invention, being peculiarly economical, convenient, and efficacious.

" *Description of the Engraving.*

" A, the outer cylinder of the radiator.

"B, the inner cylinder.

"C, an opening by which air may enter the inner cylinder.

"D, space between the two cylinders, vertical partitions in which compel the draft to descend on the side next the stove, and to ascend on the opposite side, to pass off by the smoke-pipe E.

"F, stove of the ordinary construction."

CLUTE'S IMPROVED PROCESS OF GENERATING HEAT FOR FORGING MALLEABLE IRON AND GENERATING STEAM TO PROPEL MACHINERY.

The second figure on our front page represents an apparatus for generating heat and steam, which has been lately patented by a Mr. Clute, of Sheuectady. We extract the following description of it by the inventor from the *American Railroad Journal*:—

"Where others than a cylinder boiler, or where more than one boiler is designed to be used, a given number of furnaces, of the description hereinafter set forth, are to be erected, under the same arrangement and in the most convenient form, to receive as many points of the boiler or boilers as, according to the principles hereinafter laid down, may be deemed most expedient. The cylinder boiler, however, I deem best adapted to the contemplated purposes of my invention.

"Where the cylinder boiler is used, the number and size of the furnaces will vary according to the size of the boiler, and the quantity of steam required to be raised. The furnaces are to be built in a straight line, of uniform width and height, equidistant and continuous, the boiler to be laid horizontally or lengthways on the top of the furnaces. There is an aperture at either end of each furnace, through which the coal is shoved on the grate, and the fires fed as occasion requires. Under each grate there is a box, which I shall designate by the name of receiver, because it receives the blasts from the blow-pipe and the ashes falling through the grate. The receiver may be taken out and cleaned when necessary. Each receiver has at one of its sides an aperture for receiving a branch of the blow-pipe. There are, of course, as many branches to the main blow-pipe as there are furnaces; and the blow-pipe is connected with the bellows, which is worked by the steam which the heat of the furnaces generate. The branch blow-pipe enters the receiver about its centre, at a point equidistant from the grate and the bottom of the receiver, thus causing the wind in the receiver to circulate equally. There is an aperture near the top of the furnace, in the front, through which to protrude the iron to be heated.

"This aperture may be closed by a valve when not used.

"Suppose a cylinder boiler, 20 feet long and 2½ feet in diameter; then there ought to be about seven furnaces, and the proportions of the different parts of the furnaces, &c., ought to be as nearly as may be as follows:—Distance between the grate and the boiler, 12 inches; length of grate, 18 inches; width of grate, 8 inches; width of the furnace to correspond with the size of the grate; the aperture at either end to admit the coal, to be 8 inches and 6 inches in height; the receiver, 8 inches in width and 6 inches in height; aperture for receiving the blow-pipe, 1½ inch in diameter; aperture through which to heat the iron intended to be worked, 6 inches in width and 3 inches in height; distance between each grate, ⅞ths of an inch; diameter of blow-pipe, 4 inches, and diminished to 1½ inch at the entrance into the receiver.

"The strength of the blast required is equal to that of a blacksmith's fire. The degree of heat may be regulated by valves placed in the blow-pipe."

The inventor thus sums up the advantages which he anticipates from his apparatus:—

"1st. The using a number of furnaces to raise steam; 2d, the process of heating the boiler uniformly at many points, thus differing from the universal practice which now obtains of heating the boiler at one particular point; 3d, the employing the same steam raised by the furnaces in driving the bellows connected with the furnaces; 4th, the application of the blow-pipe to ignite anthracite coal for raising steam; 5th, the using the same fire for the double purpose of raising steam and heating and working malleable iron.

"I consider these two last particulars the most important, and as in an especial manner distinguishing my invention from every other. This apparatus possesses a highly important advantage, in that it may be used for manifold purposes—for the manufacture of malleable iron into the different articles usually made by blacksmiths, and edge-tools, nails, &c.; and the steam-power may be applied to grinding and polishing the iron when manufactured, to propelling boats, driving a trip-hammer and mills of every description, and the other purposes for which steam-power is generally employed."

Description of the Engraving.

a a are the apertures for iron; *b b*, the grates; *c c*, receivers; *d d*, branches of main blow-pipe; *e*, the main-pipe; *g g*, cylinder boiler; *h h*, apertures for coal.

EXPERIMENTS ON INDIGO.

Sir,—I have lately been engaged in a set of experiments on indigo; and as that substance is now so universally known as a permanent and beautiful blue dye, it may not be altogether uninteresting to your readers to give a sketch of its chemical characters, which are very striking and rather complicated.

Indigo of commerce is by no means a pure colouring principle. It contains a variety of foreign matter, part of which it may have derived from the plant from which it was extracted, and part may have been added to it through carelessness in its preparation; of 100 parts, a good specimen will not afford more than 50 of real blue.

It is a matter of considerable importance to devise some simple, and, at the same time, economical plan of analysing this drug, not only for the purpose of ascertaining the exact quantity of colouring matter a given specimen contains, but also what is the nature of its impurities, which I have found to vary considerably in different sorts. In order to find the value of a sample with respect to its proportion of blue, Mr. Dalton proposes to dissolve one grain in sulphuric acid, transfer the solution into a tall cylindrical glass jar containing water, and then to destroy the colour by chloride of calcium, the value of the indigo being in proportion to the quantity of the chloride necessary to destroy its colour. I consider this to be, at best, a troublesome method, and not entirely to be depended upon. I made several experiments on two samples, one an excellent East India, and the other a very inferior Guatamala; but the quantities of chloride of calcium required to destroy the colours were so nearly the same, that the superiority of the East India was not manifested.

Chevreul gives us a very good method of analysing indigo in the rough manner. He directs that it be first digested with water, which will take up 12 or 14 per cent., but the quantity varies much in different samples. The water acquires sometimes a yellow, but usually, especially with Guatamala's, a dark brown colour; this solution by exposure to the air precipitates flocks, having a green colour, which appear to be partly composed of indigo, becoming blue when left in the air; the greater part continues green, is soluble in alcohol and solution of potash, but does not ever turn blue. I have found that this green matter, which is very slowly thrown down by the action of the air, is immediately and plentifully precipitated by dropping muriatic acid into a concentrated liquor; and in the specimens on which my experiments were made, the precipitate from the Guatamala was much more abundant than that from the East India; the liquor from the former was much darker than that from the latter, and it was remarked that the Guatamala was very inferior as a dye to the East India, yet the quantity of real indigo in each did not appear to vary much. I conclude, therefore, that the difference in quality was owing to a more than usual quantity of gluten and brown matter, and that these substances are more injurious than is generally supposed, tending to destroy the peculiar brilliancy of the indigo.

After water has extracted all that is soluble in that menstruum, Chevreul directs that the residue be treated with alcohol in successive portions, by which a further quantity of green matter is taken up, but so mixed with another red substance that it assumes a dark, ruby colour. Chevreul states, that 30 grains out of 100 are taken up by alcohol, which is rather more than I found. Lastly, muriatic acid takes up a further portion of red matter, together with alumina, lime, and oxide of iron; and pure indigo, amounting to 45 or 50 per cent., remains, usually mixed with a small quantity of silex.

When indigo is exposed to a temperature about equivalent to that of melting lead, it rises in the form of a beautiful purple smoke. This was known long before any attempt was made to obtain it in a crystalline form by sublimation. If, however, a proper apparatus is employed, and precautions adopted, it may be thus produced, and then assumes a very beautiful appearance. The best indigo for the purpose is that precipitated by agitating in contact with air the yellow solution of deoxidised indigo, which forms the dyer's blue vat; but where that cannot readily be obtained, common indigo may be used. In the latter case, 30 or 40 grains in coarse powder must be placed in a shallow metallic saucer, and a spirit-lamp applied to the bottom till the surface becomes covered with a copper-coloured, mossy-looking substance,

taking care to remove the source of heat the moment purple vapours appear. When the saucer is cool the crystals must be brushed off with a feather, and placed in another similar saucer furnished with a cover, so applied that the internal surfaces may not be more than half an inch apart. A second application of heat will cause the pure crystals to rise and plant themselves on the upper vessel, the impure substance remaining behind of a coaly appearance.

The crystals thus produced bear a very small proportion to the quantity of indigo employed. As an average of four experiments from 10 grains of impure indigo, I obtained by sublimation half a grain of crystals, and the residue weighed 6½ grains, showing 3 grains of volatile matter to have escaped. The crystals volatised leave no residue. When they are viewed through a microscope, they appear as long, flat, acicular crystals, appearing red by reflected, and blue by transmitted light; they are not, however, always so, sometimes, particularly at the commencement of their formation, assuming the form of very thin plates, appearing almost opaque; indeed, when lying in a mass they always have a brown colour.

Sublimed indigo may be analysed by heating it with peroxide of copper in green glass tubes. Mr. Crum gives its ultimate constituents thus:—

Carbon	73·22
Azote	11·26
Oxygen	12·60
Hydrogen	2·92
	100·

These numbers correspond very nearly to,

1 atom of azote	1·75 or	10.77
2 atoms of oxygen	2·00 or	12·31
4 atoms of hydrogen	0·50 or	3·08
16 atoms of carbon	12·00 or	73·84
	16·25	100..

I am, however, disposed to consider the quantity of carbon to be greater, and the quantity of oxygen to be smaller. I have repeatedly analysed both sublimed and precipitated indigo over peroxide of copper and protochloride of mercury (calomel), and have obtained 84 as the mean proportion of carbon in 100 parts; and it was only when calomel was employed that I obtained satisfactory proof of the presence of hydrogen. But since Mr. Crum's analysis is generally considered pretty correct, I do not at present place much reliance on my own discordant results. Organic analysis is a very delicate operation, and requires much experience and a peculiar apparatus, neither of which have I the advantage of.

In the year 1827, Berzelius published an excellent memoir on indigo. He found in it four peculiar substances, which constitute its chief ingredients, viz. 1st, a substance closely resembling gluten; 2d, a brown matter; 3d, a red matter (the resin of Bergman and Chevreul); and 4th, the proper colouring principle.

From a sample of good East India indigo I extracted the gluten by first boiling it with diluted sulphuric acid, then filtering and neutralising the acid by carbonate of lime, after which it was evaporated to dryness and alcohol boiled on the residue; this extracted a substance resembling gluten, and particularly characterised by its smell, which was very similar to broth. Gluten is itself a substance possessing properties in common with both the animal and vegetable kingdoms, hence it has been called a *vegeto-animal* substance.

The brown matter I separated from the residue left by the acid by gently heating it with a weak solution of potash, and from the residue again alcohol extracted the red matter. The alcoholic solution being evaporated to dryness, left a ruby-coloured powder, which was dissolved by nitric acid, forming a fine Port-wine coloured liquor, which colour it did not long retain, but soon, in consequence of decomposition, turned yellow.

After these operations have been performed on it the indigo is not left in a state of purity; it contains, besides insoluble impurities, a portion of the green, red, and brown matter, but by acting on it by the protosulphate of iron and lime, and pouring the yellow solution of deoxidised indigo thereby obtained into diluted muriatic acid, a copious blue matter falls down, which, after washing, may be regarded as tolerably pure.

By acting on indigo by means of protosulphate of iron and lime, Liebeg produced a substance which he considered to be pure deoxidised indigo. The proportions I used in repeating his experiment were, 1,000 grains of the drug, 1,500 of copperas, and 1,600 of lime; these were put into a stone jar, and 3 quarts of water poured on them; the whole was then heated to 130° Fahr., and

so kept for 18 hours, guarded as much as possible from atmospheric air; the clear yellow solution was then drawn off by a syphon, previously filled with hydrogen gas and mixed with diluted muriatic acid, holding in solution a little sulphate of ammonia; a thick, white precipitate fell down, which was washed with water that had been boiled, and dried at the temperature of 212°; when quite dry it retained its white colour even when exposed to the air, but when moist it speedily became blue. To this substance Liebeg gave the name of indigogen, and he ascertained that in passing into the blue indigo it absorbs 11·5 per cent. of oxygen. The preparation of this substance, owing to its powerful affinity for oxygen, is extremely difficult, and it was only after repeated trials that I succeeded in producing it. It is absolutely necessary that all the vessels employed should be previously filled with either nitrogen or hydrogen, and the water employed be deprived of air by long boiling.

The action of some of the acids on indigo is extremely interesting. With the nitric acid it forms two distinct substances, according to the strength of the acid and the manner in which it is applied. When 1 part of indigo is mixed with 8 or 9 parts of moderately strong nitric acid, and boiled as long as nitrous fumes are evolved, *carbazotic acid* is formed. When the indigo is added to diluted nitric acid kept boiling, as long as effervescence continues, hot water being occasionally added to supply the loss by evaporation, *indigotic acid* is formed.

The particulars of the preparation of each are as follows:—

To form carbazotic acid, I boiled some small fragments of the best East India indigo in ten times their weight of nitric acid; the mass frothed and swelled, giving out a large quantity of nitrous gas, mixed with carbonic and prussic acids. It is recommended by some chemists to add successive portions of nitric acid whilst boiling; but there is nothing, I believe, gained by this. I have tried repeatedly both plans. The solution is bright yellow, and contains, besides carbazotic acid, artificial tannin, resinous matter (which forms a film on the surface), and indigotic acid—on cooling, carbazotic acid is freely deposited, but not in a pure state, mixed probably with a considerable quantity of indigotic acid; the residual liquor, by evaporation and adding cold water, yields an additional quantity.

The crystals were dissolved again in hot water, which was divided into two equal portions, one of which was neutralised by carbonate of potash, and the other by carbonate of ammonia; carbazotates of potash and ammonia were formed, and repeatedly purified by crystallisation. The former salt appeared in the form of long, yellow, semitransparent, and very brilliant needles; the latter formed yellow, flattened crystals. Carbazotate of potash possesses the property of detonating when heated like fulminating silver; carbazotate of ammonia is fused and volatilised without decomposition. It may here be observed, that the sparing solubility of carbazotate of potash renders its acid an excellent test for potash. Carbazotic acid is easily separated from the salts by the addition of sulphuric acid; its crystals are in the form of brilliant, yellow plates; it is extremely bitter, and said to be poisonous; it may be fused and volatilised without decomposition, but when exposed to a strong heat it explodes, leaving a residue of charcoal.

By Liebeg's analysis this acid contains no hydrogen, but, as its name implies, it is a compound of carbon, nitrogen, and oxygen, in the proportions of 15 carbon, 3 nitrogen, and 15 oxygen. Others give different proportions, and Dumas found in it 1·4 per cent. of hydrogen. It may be formed by the action of nitric acid on many animal and vegetable substances, as silk, aloes, &c.

To form indigotic acid, indigo in coarse powder was mixed with nitric acid, diluted with an equal weight of water; carbonic acid and nitrous gas were produced, but no carbazotic acid; when effervescence had entirely ceased, it was allowed to cool; a thick, white precipitate fell down, which was boiled with oxide of lead, and filtered in order to separate the resin; the clear, yellow solution was decomposed by sulphuric acid, and filtered at a boiling temperature. Indigotic acid was deposited on cooling in minute, yellowish white needles; by repeatedly dissolving and re-crystallising, it finally assumed the form of a tuft of feathers. To purify these, Dr. Turner recommends digestion with carbonate of baryta, and subsequent decomposition of

the indigotate by an acid; it is thus obtained in acicular crystals of snowy whiteness, which contract much on cooling, and then have a silky lustre.

Indigotic acid decomposes carbonates, but is a very feeble acid; it requires 1,000 times its weight of cold water to dissolve it, but is soluble almost to any extent in hot water or alcohol. When heated in a tube, it fuses or sublimes in six-sided plates.

Dumas considers indigogen, indigo blue, and indigotic acid, as oxides of the same compound radical, and gives their constitution thus:—

	C.	H.	N.	O.	Equi:
Indigogen	275·4	+ 15	+ 42·45	+ 32	= 364·85
Indigo blue..........	275·4	+ 15	+ 42·45	+ 48	= 380 85
Ditto in 100 parts	72 8	+ 4·04	+ 10·8	+ 12·36	
Indigotic acid	275·4	+ 15	+ 42·45	+ 240	= 572·85
Ditto in 100 parts	48·23	+ 2·76	+ 7·3	+ 41·28	

I have yet to examine the phenomena attending the action of sulphuric acid on indigo, which are very singular and somewhat complicated; but I think it better to defer my remarks to another month. In the mean time have the honour to remain,

Your obedient servant,

G.

Bath, August 21, 1835.

FIRE-PROOF BUILDING—ORIGIN OF FIRES, AND SUPPLY OF WATER AT FIRES.

Sir,—I observe in your last Number, that your talented correspondent, Mr. C. Davy, has promised to resume the subject of fire-proof building, a subject of the utmost importance to all classes of the community, and one that will most probably receive a more than ordinary share of attention at this time, when fires have become so unusually prevalent.

Builders, in general, have hitherto manifested a most surprising indifference towards this matter; except in a few particular instances (mostly public buildings), little has been done to arrest the progress of fire, beyond the imperfect compulsory measures enforced by legislative enactment.

In Mr. Davy's last letter he states an opinion at which I am greatly surprised, "that the majority of fires are not accidental." This is an extraordinary mistake; all fires originate either in *accident* or *design;* the accident may arise from natural, unforeseen, and unavoidable causes, from carelessness or from ignorance; sometimes from a combination of all these causes.

All persons who have had any opportunity of tracing the origin of metropolitan fires, must come to a conclusion the reverse of that held by Mr. Davy. I would refer Mr. Davy to the Reports on London fires published in your Magazine for the last two years, wherein the causes—so far as the most diligent examination could ascertain—are particularised; even if the whole of the fires whose origin could not be ascertained, were added to the list of wilful, still it would not constitute *a large majority*.

In the paragraph which you have copied from the *Times* of the 21st instant, alluding to the extraordinary increase of fires during the last few weeks, Mr. Braidwood is said to be of opinion, "that the cause of the late great increase and rapid spread of fires is to be found in the extreme dryness of the season." That the extreme heat and drought of the present season has greatly influenced the *spread of fires*, there can be no doubt; but, that the weather can have had any share in increasing the *number* of conflagrations, is absurd in the extreme, and I think the writer has taken no small liberty in fathering such an opinion upon Mr. Braidwood.

Allusion is made by the same writer to the New River Company's imperfect supply of water at some of the late extensive fires. The New River Company have certainly been practising the most rigid economy in their water supply, doling out their streams in the most sparing manner, and at some of the late fires the supply was certainly very indifferent. There are, however, many circumstances which co-operate to render an ample supply of water at extensive conflagrations exceedingly precarious. In places where no mains are situated, water is not to be obtained until the attendance of the turn-

cock has been procured; and as it is every body's business to send for this functionary, nobody thinks of doing so till it is too late for him to be really useful. But supposing, as it does sometimes happen, that the turncock is on the spot on the breaking out of a fire, the water is turned on, and the plugs opened, but much of the water runs away to empty cisterns, &c., and but a scanty supply of water comes through the plug for some little time. Again, in many localities the plugs are too few in number, and too small in size, to meet the exigencies of large fires. The waterway is often under two inches; and there are many plugs on service-pipes that will scarcely keep two engines supplied.

In the event of a tolerable supply of water being obtained at the beginning of a fire from one or two plugs, there is every chance of the fire being stopped, and the supply of water would be considered ample; but should the fire have attained so great a head as to require the united efforts of eight or ten engines for its suppression, the same supply of water which in the first case would have been considered plentiful, would now be complained of, and pronounced deficient. This circumstance may be illustrated by allusion to the fires in Cripplegate-buildings, and in Rupert-street, Haymarket, which occurred at the same time, and were both in the New River Company's district. In the first case, a small quantity of water skilfully applied stopped the flames, and the supply was said to be good. In the second instance, a much larger supply was said (and truly) to be deficient.

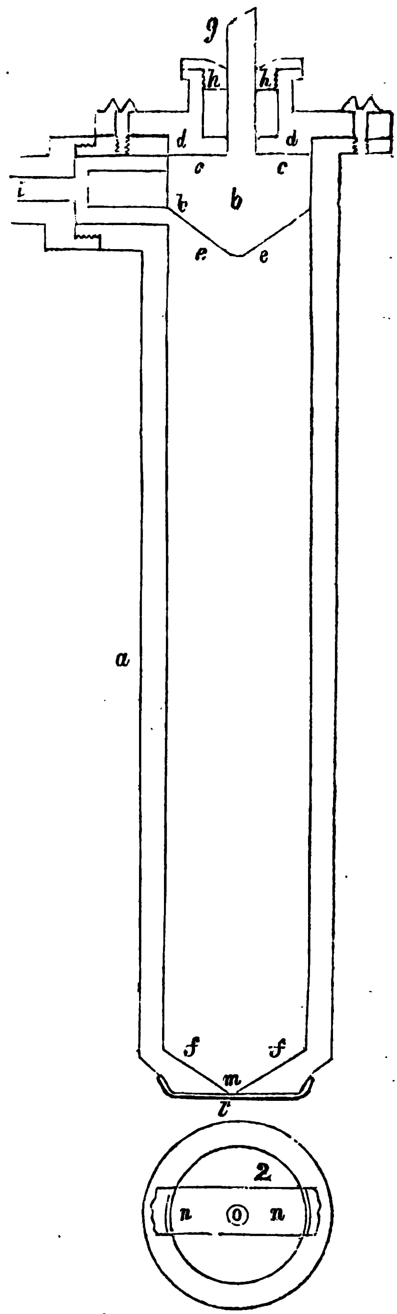
To render the supply of water adequate to the requirements of extensive conflagrations, would require an alteration in the mode of supply. The plugs should be increased both in number and size; or, what would be infinitely better, the plugs should be entirely dispensed with, and replaced by fire-cocks with a waterway of two and a half, or three inches, on seven inch *mains*. These, in conjunction with some means of readily and conveniently collecting the water, to supersede the necessity of breaking up the paving-stones, would go far towards preventing a recurrence of scenes like those so lately witnessed.

I remain, Sir, yours respectfully,

WM. BADDELEY.

London, August 29, 1835.

IMPROVED SINGLE-VALVED AIR-PUMP.



Sir,—The annexed figures represent an improvement in the valve of the "Improved Single-valved Air-pump," p. 328, vol. xxii., Mechanics' Magazine.

a a (fig. 1) represents the pump barrel; *b*, a solid piston, the top of which, *c*, is made to go close to the cap *d*, and the bottom, *e*, to go close to the barrel at *f*; *d*, the cap through which the piston rod, *g*, must slide air-tight by means of a stuffing-box *h*; *i*, a passage to the receiver, divided into two branches, so that when the piston touches the cap, the lower passage, *k*, may be close below the piston *l*; the valve made of a slip of gold-beaters' skin tied over the hole *m*.

Fig. 2 represents the bottom of the barrel *n*, the slip of gold-beaters' skin tied over the holes for a valve. When the piston goes to the bottom of the barrel, it will slightly open the valve that all the air may freely escape.

The improvement is in the simplicity of construction of the valve and piston, without losing any advantage that other pumps may have.

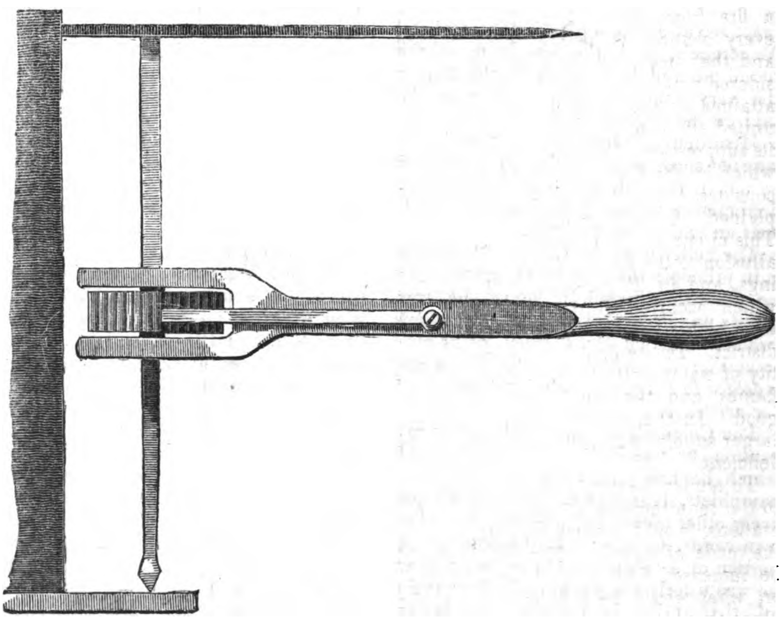
I am, Sir,

Yours respectfully,

R. Haddrick.

Gateshead, June 8, 1835.

SIMPLE DRILL.



Sir,—The above sketch represents a very simple and efficacious drill, the invention of a workman, I am informed, at Mr. Hague's manufactory. The inconvenience attached to the use of a large drill, when holes are required to be made in a confined situation, such as flanges, iron railings, &c.—it being in such cases impossible to accomplish the requisite rotary motion—appears to have been the primary cause of this ingenious arrangement. The sketch needs but little explanation. Attached to the handle of the drill is a ratchet-wheel and strong spring; the revolution of the drill is performed by an alternating action of the handle.

Numerous are the arrangements adopted by intelligent workmen for economising time and saving labour, and it is to be regretted, that many of these contrivances never emerge from the workshop or factory in which they originate. Publicity would, in all probability, be the means of raising from a subordinate situation, artificers whose practical talents

do honour to themselves, and reflect credit on the natural ingenuity of the working classes of this country.

I am, Sir,
Respectfully yours,
C. Davy, Architect.

3, Furnival's-inn, August 17, 1835.

MR. OGLE AND COLONEL MACERONE.

Sir,—From the quality of Colonel Macerone's compositions, more particularly his pamphlet, I feel averse to go much farther than my demonstration in your number of August 8, in which the drawings of a boiler *constructed and finished* in 1832 by me, at the factory at Millbrook, near Southampton, is placed side by side with the boiler claimed by Colonel Macerone as his invention. As the mechanic must see at a single glance that Colonel Macerone's, with the exception of the round pot and little pipes on the top, is the very same, nothing more need be said on the subject.

His attempt to insinuate that the boiler was not constructed at the time specified by me, is beneath notice; nearly a hundred men could testify to that fact, which puts an end to the question.

The boiler used by Colonel Macerone is in principle the very same, and before he constructed such a boiler, he was utterly unable to make the vehicle, *which had been built by Mr. Gurney, go at all;* so neither the *vehicle nor the boiler are indebted to the great genius of the Colonel for existence.*

The Colonel's account of the great invention to which he lays claim, and which he has puffed and trumpeted in pamphlets, letters, &c. (while he abuses every other mechanic) amounts, from his own words, to this:—That having got a portion of a vehicle at Gurney's auction, he was utterly unable to make it answer, and that at last he commenced a boiler similar to that of Ogle and Summers, viz. an air-tube within a larger water-tube, and an aggregation of such double tubes in united sections. The Colonel says he threw it away, as it was difficult and expensive even to imitate. I can readily believe him;—then with *wonderful talent*, being unable to devise any efficient steam-generator, he actually, after much profound thought, determined *on leaving out the inner air-tube*, and putting together many tubes with a pot on the top of them, and little pipes running into it. Unfortunately such a boiler, without the pot and little tubes, had been completed, and stood ready for use in the factory at Millbrook. Then this great inventor, with machinery constructed by another and a boiler evidently copied from one admitted to be the best extant, positively breaks through a house, runs into ditches, lies sprawling in the Edgeware-road, and, at last, runs a few times about the hard flat roads near London!! Then claims the first rank in steam-locomotion, writes a pamphlet, in which he has collected all the tittle-tattle of all the prating people who pretend to information on the subject, and with the credulity of imbecility, and the envy of a man conscious of not having a shadow of claim to the rank he has assumed (with Gurney's machinery and a boiler which every body knows is merely Ogle and Summers' patent without the air-tubes), plays the part of the jack-daw in the fable, and expects that his empiricism and abuse are to be borne in silence. His manner of writing, his presumptions, assumptions, and the insinuations of a want of veracity in others, are weapons used in the rhetoric of empirics, but are inadmissible in the pages of manly scientific discussion.

Colonel Macerone, in his usual presumptuous strain, assumes that I have used no other boiler than that patented by Summers and Ogle in 1830. It was with the boiler finished in 1832 that I travelled in an old vehicle to Tunbridge, thence to Maidstone, &c. and to London. It was with the *patent boiler of Ogle and Summers* that a very large vehicle started from Millbrook, two miles from Southampton, with twenty-six persons and much luggage, and reached Winchester (fourteen hilly miles) in one hour and seven minutes, blowing off steam the whole way, and proceeded to Oxford, where the axle broke. Let all the present aspirants in steam-locomotion try those sixty miles, and they will find it very different to running about London, or even to Reading or Marlborough.

Two vehicles now ready have boilers, neither in accordance with the patent of 1830, nor the experimental boiler of 1832. They are of my own construction, and will henceforth be used by me as being superior to both.

I pass over the extract made by Colonel Macerone from a provincial journal, as the paragraph is evidently the compo-

sition of some good-natured, quizzing person not conversant with steam-carriages. The vehicle went with a party from Tunbridge to Maidstone, fourteen miles in three quarters of an hour.

Colonel Macerone's pamphlet places him without the pale of that courtesy which I have ever used and wish to use in discussion; if, therefore, he smarts at being shown to the world as a mere copyist, boasting of his vast originality, he may thank himself and his disgraceful pamphlet for the exposure. The story of the old fumbling workman who was employed by me during the winter to rivet a few tubes, might be known as Colonel Macerone's, and only merits the same ridicule and contempt as his pamphlet and his insinuations.

I have now done with this original inventor! unless he requires still severer retort, and

I am, Sir,
Your very obedient servant,
NATH. OGLE.

56, Baker-street, Portman-square,
August 29, 1835.

P. S.—As Mr. M'Curdy's duplex generator seems in the little pipes to bear some similarity to a number of little pipes in the generator claimed by Colonel Macerone, I merely say, that Mr. M'Curdy's generator is neither in principle nor structure similar to mine, and wholly useless for locomotive vehicles and high pressure. Mr. M'Curdy honours me with the title of *Captain*—I beg to assure him that I have no claim to the appellation.

A FEW WORDS IN DEFENCE OF THE SHIPPING INTEREST.

Sir,—An article in your 261st Number, entitled "The Ship-sinking System," has excited my astonishment—astonishment, that any one professing to be so intimately acquainted with the system pursued at Lloyd's, should venture under the name of "A First of June" to put forth such atrocious calumnies upon the conduct of the underwriters, ship-builders, ship-owners, and merchants of Great Britain. The writer asserts, that "under pretence of classification of merchant-shipping, they have apparently taken the most effectual measures to prevent safe vessels being built," and that "an *invidious* system of classification has been recently revised," and what is called a "New System of Registration adopted;" which "new system is just as much in the shipwrecking interest as the old, the entire tendency of it being to take away all inducement from the ship-owner to study strength of construction by classifying ships according to their age, *without any regard to their strength.*" He goes on to assert, that "after a ship has lasted nine years, it is at once reduced to the second class, no matter what its strength may be." It would be difficult to conceive of a more gross misrepresentation of fact than the preceding extracts convey. The falsehood of the assertions will be instantly manifest on reference to the rules of the "New System," which recognise as a leading principle, that the classification of ships shall "be determined by reference to the original construction and quality of the vessel, the *materials employed*, and the *mode of construction.*"

This is, "indeed, a most ingeniously devised system of iniquity," just such as might be expected from the known probity and honour of the "parties who have had the concocting of it!"

It is not my intention to attempt the defence of a body of men, who, for the purpose of accomplishing their atrocious designs, have also declared that the rules "may at all times be altered by the presiding committee, and *especially*, to meet any *acknowledged improvement which may be made in Naval Architecture, or in the materials used in ship-building.*"

Such a declaration, without at all entering into a further detail of the rules, is sufficient to convince every ingenious mind that the underwriters, ship-builders, ship-owners, and merchants, are *not* banded together to take "the most effectual measures to prevent safe vessels being built," and "to take away all inducement" to study strength of construction in the vessels which may hereafter be built for the merchant service.

There is a party who have for some months past been labouring most assiduously to fix a much lower standard of quality than "the worthies of Lloyd's" are disposed to admit as good risks. From certain expressions in the article now under notice, there are strong grounds for believing that the writer of it is more closely connected with that party than he would like to be known.

It is unfortunate that your correspond-

ent should have referred to ships of war as models for strength, which merchant builders would do well to imitate, it being notorious that ships of war, when taken into the merchant service, have always required additional strength to enable them to carry their cargoes with safety. Yet your correspondent recommends that the slight and inefficient scantling of men-of-war for mercantile purposes shall be substituted for—one which has proved to be better adapted to the purpose, but with the details of which he is evidently not acquainted.

The extraordinary cases quoted by him, even if true in all their details, are of vessels which were constructed with an unusual degree of strength for a particular purpose, but not more so than vessels of the same class are constructed for the merchant service in London. The "First of June" refers to the "Superb" in proof of the inferiority of merchant steamers. Does he know the construction of the "Superb," her age, where built, and the precise circumstances under which she was lost? Unless he possesses full and correct information on these points, he is evidently incompetent to adjudicate in the case of the "Public *versus* Merchant Steamers."

The writer of this not long since saw one of the *King's ships* take the ground when *quite empty*, and in the course of a few days *break off* just above the floorheads, being *too weak* to sustain her *own weight*, notwithstanding she laid on a bed of soft mud. Are these the kind of ships, having 15 to 21 inches of solid timber, which the "First of June" recommends to be built for the merchant service, when they have occasionally to take the ground with their cargoes?

I might enter into an examination how far the plan of filling in solid conduces to the durability of the ship, but forbear, not feeling myself called upon to do so in the present case.

I send you a copy of the Rules for the classification of ships in "Lloyd's Registry of British and Foreign Shipping," in order that *you* may be able to judge whether the tendency of them is "to *prevent* safe vessels being built." Your integrity and candour will admit that, on the contrary, *every inducement* is held out to study *strength of construction*, with a proper regard to the *selection of such materials* as will be most likely to *ensure the durability and sea-worthiness* of *all ships* which may hereafter be built for the merchant service.

I am, yours respectfully,

An Old Correspondent.

[We have looked over the Rules, a copy of which accompanied the preceding communication, and must frankly acknowledge that they have left on our minds a very different impression of their tendency from that conveyed by the letter of "First of June." But before offering any decisive opinion on the subject, we should like to see what that writer has to say in support of his charges. We find it difficult to persuade ourselves that any gentleman could denounce in such unmeasured terms as he has done the new Rules of Registration, without having much better grounds for his conduct than any which a perusal of the Rules themselves have suggested to us.—Ed. M. M.]

WOODHOUSE'S SUBSTITUTE FOR CANAL LOCKS ANTICIPATED BY FULTON.

Sir,—It has frequently occurred that two individuals have, at distant times or places, hit upon the same expedient for accomplishing the same object. The plan described in No. 623, as a substitute for canal locks, is precisely similar to one given by the late Mr. Fulton in his thin quarto work on canal navigation. I was not aware that it had been in actual practice. In the same work, "Fulton on Canals," is a plan for transporting canal-boats from one level to another, which he stated might also be applied for the purpose of facilitating the repairs of the boats used on the canal. The late Mr. Morton, of Leith, took out a patent for the three kingdoms for a slip of precisely the same kind for repairing vessels. I am inclined to believe that Mr. Morton never either saw or heard of Fulton's plan, and was, therefore, so far an original inventor.

Can any of your correspondents furnish a detailed account of a steam-raft recently fitted in the Surrey canal, which, from the description given me, is similar to that lately constructed in the United States?

I am, Sir,

Your obedient servant,

George Bayley.

London, August 21, 1835.

THE NEW PAVING ON SNOW-HILL.

Sir,—Your intelligent correspondent, Mr. Baddeley, has lately noticed a new mode of paving recently adopted on Snow-hill. The sketch that accompanies his communication is (either from the oversight of the draughtsman or engraver) not correct. As Holborn-hill is shortly to be paved in a similar manner, perhaps he will favour your readers with an amended representation and a particular account of the substratum, and the proportions of the grouting, if any, employed in bonding the work together. The plan recently adopted I consider to be good in principle, and, I may add, the best that has been hitherto tried for great acclivities. But certain destruction awaits the knees of any animal that may fall upon its ridged surface, till such time as the granite is reduced on its edges by the action of heavily laden waggons. At the same time I would suggest, that this plan should be adopted at the entrance of all branch streets and gateways that have an intervening gutter. The accidents that arise from the common practice of cross-paving at these particular points, are innumerable. Would it not be better to have the stones roughly rounded or prepared previous to laying? For I feel convinced, from careful observation, that a weight, equal to a waggon laden with coals, has a tendency to displace this paving considerably; besides, forcing large portions from the arris edge of the stones, thus rendering the improvement no better than that which has lately cost our worthy Corporation about 300*l*.

I am, Sir,
Respectfully yours,
C. Davy, Architect.

3, Furnival's-inn, August 17, 1835.

RECENT AMERICAN PATENTS.

(Selected from the *Franklin Journal* for May, June, and July last.)

Improved Suction Pump, *Elijah Whiton, Massachusetts.*—The barrels are to be made of steatite or soap stone; but the principal novelty is a contrivance for opening both the valves, and allowing the water to descend to prevent its freezing. There is to be a sort of spring catch on the upper surface of the valve of the lower box, which, when the pump handle is raised to the greatest possible height, hooks on to a ring, or other suitable appendage, on the lower end of the piston, whilst, at the same time, a projecting pin opens the valve in the piston, or bucket, and the water necessarily descends into the well, or reservoir.

Straw Cutter, *Stephen Ustick, Philadelphia.*—There is, we think, considerable novelty in certain parts of this machine, but it has the fault of too much complexity. The straw is to be contained in a trough, in the usual way, and is to be fed by fluted rollers of cast-iron. The knife stands horizontally, or nearly so, across a frame to which it is firmly attached. The lower edge of this frame rests upon ways, which form an inclined plane, and, consequently, as the frame slides, the knife descends with a drawing motion. To cause the frame to slide backwards and forwards, there is a pitman, worked by a crank, on the shaft of a fly-wheel in front of the machine.

Preserving Timber from Decay, *Forrest Shepherd, Fredericksburg.*—The wood is first to be steamed, or boiled, to "destroy the sap, or principle of decay," and after this to be immersed in pyroligneous acid, until saturated. The patentee says that he also preserves wood from decay, and from destruction by worms, by boiling it in a solution of sulphate of iron, sulphate of alumine, and muriate of soda; or, in other words, in a solution of copperas, alum, and common salt, taking half an ounce of each to a gallon of water.

We apprehend that the foregoing directions are altogether empirical, and that the patentee has been guided more by his hopes than by his experience, which ought, in such a case, to be the result of long continued and varied observation. A patent was lately obtained for saturating timber with lime, which was to neutralize the acid supposed to be contained in it; in the present instance, it is to be made to imbibe as much acid as possible; these views are theoretical, or rather hypothetical, and must not be depended upon as guides. The present patentee's specification makes no claim, offers little or nothing that is new, and merely lays before us several recipes, from which to make a choice. The saline solutions named will do much towards rendering the wood incombustible, if they do not protect it against the attacks of the dry rot.

Horse-Shoe-making Machine, *E. D. Barre, and S. Field, Oakham.*—In the lower part of a very stout frame of east-iron, a horizontal spindle is to run, in the manner of a lathe mandrel; one end of this spindle is to project through a collar, and to carry a kind of chuck, the face of which is to be grooved, so as to form a mould, into which the heated iron is to be forced in order to convert it into shoes. This moulding face is

to be about sixteen inches in diameter, and the groove about two inches clear of its edge. When horse-shoes are to be formed, the indentations for two of them are contained in the circle, two cutters, or chisels, being placed in it to divide the iron; for ox shoes, four such cutters are used. There are to be creasing dies, corresponding with the number of shoes, on which are raised as many projections as there are nails to be employed. A punch, or punches, operated upon by cams, and passing through the moulder are to throw the shoes out of the groove.

In order to force the iron into the moulding-groove, there is a roller revolving vertically, the lower end of which roller projects through a collar, and bears against the face of the moulder. The heated bar is to be passed through an opening, or notch, which guides it between the roller and the groove, by which it is to receive its form.

We do not see in this machinery any thing calculated to remove the difficulties which have been hitherto encountered in the attempts to make horse-shoes by rolling. There has in every instance, we believe, been a considerable waste of metal, and fins have been left upon the edges, which not only increase the waste, but are difficult to remove; and, after all, the horse-shoe is not completed by the machine, but has to undergo considerable forging to prepare it for use. We predict, therefore, that it will prove a total failure.

FURNACE FOR HEATING BAR IRON, *Henry Burden*, *Troy*.—The patentee states that the common method of constructing furnaces for heating bar iron by anthracite (Welch coal), is to make them about three feet wide, and four or five long, with grates of these dimensions, and a door at one end for admitting the fuel, and the bars to be heated; the grates have on them a layer of three or four inches in thickness of ignited anthracite, upon which the bars are laid; but as flame from this fuel will not fill the space between the iron and the arch, and the heat is unequally distributed, the draft through the grate being more obstructed in one part than in another, the bars are frequently overheated, burnt, or melted, in spots.

To remedy this defect, the improved furnace is lengthened about one foot, and furnished with a door at each end; the anthracite is laid on the grate as usual, and when the bars are heated to such a degree as not to endanger their burning, the hinder door is opened, and a small portion of bituminous coal thrown into the back part of the furnace, which, flashing into flame, fills the furnace therewith as it passes over the iron in its way to the chimney, and equalizes the heat of the bars.

The improvements claimed are, "1st. Making the furnace with a door at the back end, so as to admit of the bituminous coal being put into the back part of the furnace. 2dly. Using the bituminous coal on a part of the grate at the back part of the furnace, reserved for that purpose, which gives the coal an opportunity of ignition, as well as could be by a reverberatory or puddling furnace, before it comes in contact with the iron. 3dly. In combining the use of anthracite and bituminous coal, for the purpose of heating bar, or other iron, at the same time igniting each in separate parts of the furnace."

From the nature of the thing, as set forth, and the known talents and experience of the patentee, we have no doubt whatever that the foregoing is a real and great improvement in the process to which it appertains.

ROTARY CYLINDER CANNON, *John W. Cochran*, *Massachusetts*.—It is believed by the inventor that "in actual service, either in attack or defence, the Rotary Cylinder Cannon will constitute a most formidable battery, being so constructed that discharges to almost any given or requisite number, and in rapid succession, and in a very limited period, may be made with accuracy, and with as unerring aim as with any other ordnance."

So far every thing is quite *promising*; but the value of promises, all will admit, is dependent upon the manner in which they are fulfilled, and, for our own part, we had rather be among those to be fired at, than in the company of the cannoneers, when this gun is discharged, as we should be much more in fear of the breech than of the ball. The barrel part of these guns is to be formed and mounted upon a carriage as usual, but the breech is to consist of a solid metallic cylinder, the periphery of which is to bear against the bore of the cannon, and to be capable of revolving upon gudgeons. This cylinder is to be bored so as to form any desired number of chambers, which are to receive the charges, and these are to be brought round in succession, so as to coincide with the bore of the gun. The breech is to be made to revolve by an endless screw working in a toothed wheel, and there is a contrivance intended to deposit, upon a nipple, percussion caps, which are to be exploded by a hammer. To render this gun the more formidable, it is represented in the drawing as double-barrelled, the two barrels to be discharged at the same time, two chambers being excavated in the cylinder, side by side.

We think it very probable that the pa-

tentee would never have needed a patent, excepting, perhaps, a patent coffin, had he, before seeking to obtain it, "made, constructed, and applied to use, his said invention or discovery." Our reasons for this opinion will not be required by those who have any knowledge upon the subject, and we cannot take time to prepare a horn-book for others. Even the firing of ordnance by percussion locks has been attended with difficulties of no ordinary character, as is well known to many who have tried it.

Gas Metre, *James Bogardus, New York.*—The gas metre described in the specification attached to this patent, differs in its principle of action from all those which have preceded it, or, at all events, from those which have come to our knowledge. Its exterior form is that of an oval shade, such as are put over time-pieces, the longest diameter of which is about nine inches, its shortest six or seven, and its height fourteen. This exterior part is to be made of cast-iron, in two pieces, being divided by a vertical plane passing through its longer diameter, flanches being cast along its edges, to allow the two halves to be united by means of screws; this vessel has a bottom, so as to form a perfectly close box, and it stands upon short feet. On the front side of it there is an opening, formed in the casting, which is filled with glass, cemented in, air-tight, and affording a view of the index, and of the general operation of the machinery contained in the interior. In the lower part of this case there are two openings, one for the introduction of the gas from the reservoir, and another to allow of its exit to supply the burners.

We shall not attempt to describe specifically the construction of the interior, but merely to make known the general principles upon which the indications of this instrument depend. When the two shells are put together by their flanches, they are made to embrace a flexible diaphragm, of bladder, or air-tight cloth, which is loose, or bagging, in the interior, so that when gas is forced in on one side, the diaphragm will pass over to the other, and come into contact, or nearly so, with the shell. The induction and exit apertures above spoken of, are connected with pipes, which are cast on to the bottom, and are so constructed that they can communicate with either side of the diaphragm, there being a moveable cup, or cover, which is shifted at every vibration, thus producing an effect resembling that of the slide valve of a steam-engine. The diaphragm, of which we have spoken, is in part embraced between plates of sheet tin, leaving its edges and upper part free to obey the pressure of the gas admitted; this sheet tin works on pivots at the lower end, and can, consequently, vibrate backward and forward with the diaphragm.

When the gas is admitted on one side, that on the other is forced out, by the action of the diaphragm upon it, and this, at the end of its vibration, reverses the communications between the induction and exit pipes, causing the gas to be admitted, and discharged, from the opposite sides. The same vibrating diaphragm acts also upon the wheel work by which the indices are moved, which point out the quantity of gas which has passed, by counting the vibrations, as one must necessarily be a measure of the other.

Screw for Propelling Canal Boats, *William Burk, Pennsylvania.*—"The machine is on the principle of a screw, the worm, or thread, as it may be termed, being made to wind round a small shaft, one, two, three, or more times, as will best suit the motions of the machine. The size of the screw to be regulated by the size of the boat. The machine is intended to be applied to either end, or both ends, or both sides, or in the middle, of the boats intended to be propelled. This machine has an advantage over all others as to facility, and passing through the water with the least agitation." So says the patentee, but if we are to be guided by the result of experiment, repeatedly made, we shall be compelled to pronounce it to be one of the least efficient of all the plans tried. Who was the first inventor, we have not sought to learn, but there is a full description of the same thing in the "Annals of Philosophy" for 1818, vol. xi. p. 138.

Were our canals and rivers filled with some semi-fluid, having a good portion of tenacity, these screw propellers might travel onward without scattering or communicating a rotary motion to it, as they do to water, whilst the boats to which they have been attached, have advanced with no more than a snail-like speed.

Circular Tenter Bars, *Stephen R. Parkhurst, Rhode Island.*—The whole title of this patent is for "the tentering and drying all kinds of woollen and cotton goods;" and the contrivance appears to be a very good one, performing, in a small space, what, by the ordinary method, occupies considerable room. The apparatus consists of two wheels upon a shaft, which must be of such length as will allow the wheels to stand at such distance apart as shall be equal to the width of the cloth to be tentered; by means of a screw, the distance of these wheels may be easily regulated. Upon the inner surface of each wheel, a spiral of wood or metal runs from the shaft to the periphery of the wheel, the threads of the spiral to be about four and a half inches apart. Holes are bored through these spirals, at the distance of from two to

four and a half inches apart, and through these holes there pass iron pins, which slide and turn freely in them, and have heads formed on the outer, and hooks on the inner, side of the wheel. The shaft and wheels are supported on a suitable frame; one end of the cloth is attached by hooks near and parallel to the shaft, and the edges to the spirally-placed tenter-hooks; after which the cloth is to be properly strained in width, by means of a screw nut, which removes the wheels farther apart. The diameter of the wheels will be governed by the length of the cloth to be received on them.

The advantages of the machine are, that it may be used in a small room—it renders the cloths even for rolling up—keeps the nap perfectly smooth, and expedites the drying.

COOKING BY GAS.

Sir,—In the Mechanics' Magazine of 4th July last. I notice a quotation from a New York paper on the subject of cooking by gas. The letter from which that quotation was extracted, was addressed by me to Lambert Suydam, Esq., President of the Manhattan Gas Company, New York. I beg, through your publication, to confirm all the statements there made, except that of the probable number of families now using gas for cooking in England, which has certainly not come up to my expectations; but such is the present demand for apparatus, that by another summer, I have no doubt, thousands will be in use.

In my own house we light no fire but gas, nor shall do even in winter, for cooking. Our servants are delighted with it, and can manage it well. With the expense of twenty to thirty cubic feet of gas, at 10*s.* per thousand feet, we have dressed a dinner, consisting of roast, baked, hashed, and boiled, sufficient for a party of twelve persons; and for an expense of two feet of gas per hour, we can have boiling water all day and steam for cooking, if required. My apparatus has cost me about 5*l.*, but is rather large, as my family consists of eleven persons, servants included.

Your humble servant,

JOHN BARLOW.

19, Colebrook-row, Islington,
August 15, 1835.

P. S.—Mr. James Sharp, of Northampton, made my apparatus, and he is the person who, as I have stated, locks up his house and goes to church, leaving his dinner to the care of the gas.

NOTES AND NOTICES.

Railway Experiments.—Professor Barlow, of Woolwich, assisted by Mr. Stephenson, Mr. Vignoles, Mr. Locke, and other engineers, has been conducting for the last three days, in presence of a deputation of the directors of the principal railway companies, and particularly of the London and Birmingham Railway, a series of very interesting experiments on the rails, chairs, sleepers, &c., and the mode of attaching them. The *Swiftsure* locomotive-engine, made by Messrs. George Forrester and Co., of the Vauxhall-road Foundry, in this town, attended the scientific party.—*Liverpool Advertiser.*

The Comet.—A correspondent of the *Dublin Evening Mail*, who signs himself "Charles Cameron," of Dungarvan, says he distinctly saw the comet *with his naked eye*, on the morning of the 17th instant, which was at least one month before the time astronomers have fixed for its being seen by the unassisted vision of any other person. The Irish star-gazer seems to have had a much better view of the heavenly body than our astronomers with their best telescopes, for whilst they speak of it as a scarcely perceptible nebuloid, he says he could distinctly *see its oblong form*, and that it appeared much brighter than Sirius on the clearest night. Another Irishman boasts of having seen *two* comets. One may guess what produced this second sight.

London and Greenwich Railway.—The works of this undertaking, which Mr M'Intosh has contracted to complete, are now proceeding with the utmost activity; an average number of between five and six hundred men being employed daily; and the purchase of the remainder of the property through which the railway will pass, is proceeding in a most satisfactory manner, affording the most pleasing anticipation of a speedy commencement of the running of the carriages now collecting at the depot at Deptford. The works already extend from Deptford to the Neckinger-road, and, again, from London Bridge to Bermondsey-street, leaving only the distance of about 1,200 yards to join and complete the main works from London Bridge to Deptford; and the value being fixed for a great part of the property not pulled down, it only remains for the legal forms of transfers to be executed, to put the Company in possession of the whole of the ground to that extent. It will be satisfactory to the shareholders to learn, that from an examination of the cost of the works, of which so large a portion is now erected, and the purchases effected of so much of the property, it is the opinion of the engineer and surveyors, that the original estimates will not be exceeded; and that the value of property possessed by the Company which they will have to re sell, will, it is calculated, realise full, if not more than one-fourth of the whole purchase money.

H. F.—Messrs. Barclay and Sons, Farringdon-street.

Communications received from Mr. Davy—Colonel Macerone—T. C.—Mr. Coggan—Mr. Dines.

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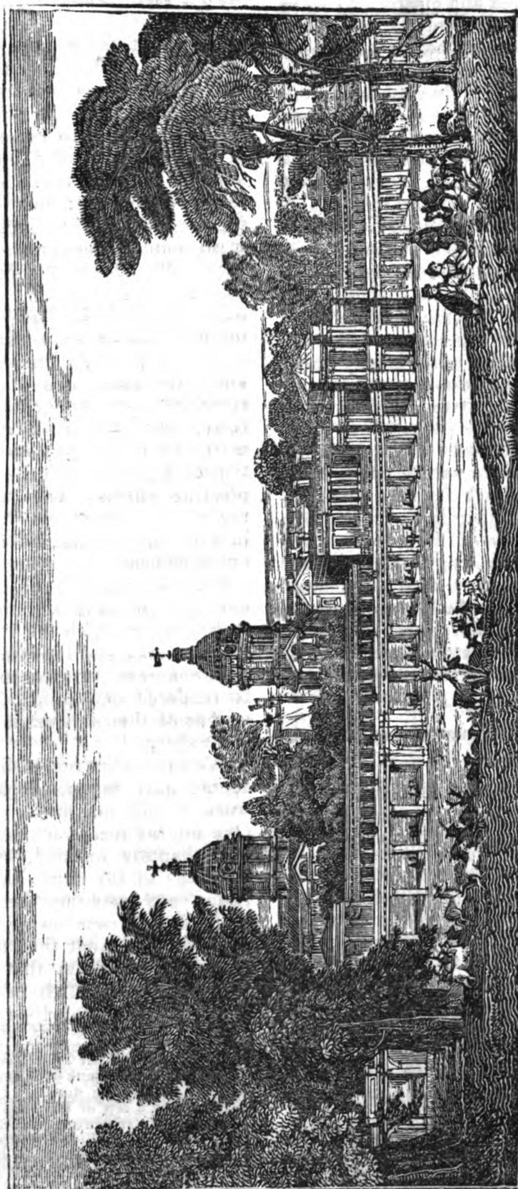

GREENWICH PARK RAILWAY VIADUCT.

GREENWICH PARK RAILWAY VIADUCT.

The 10th of Mr. Herapath's excellent series of papers on Railways, given in our present Number, is devoted to the Greenwich Railway, and will be found to contain a much fuller and clearer exposition of the merits of this interesting undertaking than has ever before been published. We have always thought most favourably of it, and are glad to find our opinion confirmed by so high an authority as Mr. Herapath's. On the completion of this railway—an event which cannot now be far distant—it is proposed to extend it to Woolwich and Gravesend, and, to avoid the inconvenience of a circuitous route, that it shall be carried, by means of a handsome viaduct, straight across Greenwich Park. Some opposition is threatened to this scheme, on the ground of the viaduct's being likely to mar the beauty of the park; but it is only necessary, we think, to take a glance at the accompanying engraving, which presents a view of the proposed structure as it will appear in combination with the surrounding landscape, to be satisfied that there is no ground for such fears. It will obviously increase rather than detract from the picturesqueness of the scenery. We have borrowed the engraving from the *Railway Magazine*—a monthly journal recently started, to which we could cordially wish a much more prosperous career, than the meagre character of its contents will allow us to anticipate.

ON RAILWAYS. BY JOHN HERAPATH, ESQ.

NO. X.

The Greenwich Railway.

There is an old adage which says, "See before you speak; for though you may speak truly, you may not justly." Never had I more powerfully felt the force of this old saw, than I did in a visit lately made to the Greenwich Railway. I had spoken of this railroad in my second Number as a bold and singular project, but in order to form a true estimate of it, I now found one must see and become acquainted with its details; aye, even with its "engineering details," as Sir John Rennie would call them.

This railway, it is well known, is to proceed from near the foot of London Bridge on a viaduct 22 feet high, supported by about 1,000 arches, to Deptford and Greenwich. In so short a distance as 4 miles, great differences in the under soil were hardly to be expected. However, substrata of clay, gravel, sand, peat, bog, and floating-land, seem to have presented themselves in luxuriant variety, the best soil often in juxta-position with the worst. But with these the engineer has successfully contended, so that it would require a professional eye to discover any effect of settlement out of 575 arches already built.* In general, the arches are segments of circles; but almost every species of arch in use, except the Gothic, is pressed into service as circumstances need. The eye is occasionally arrested by an arch commencing with the segment of a circle, and when looked through, presenting a parabola or part of an ellipse. Professional men well know the difficulties of such oblique structures, yet, as far as I could perceive, there was no deficiency of symmetry or regularity, while the transition of figures seized the mind with its pleasing effects. The prevailing character of the work may be summed up in uniform neatness and strength without heaviness.

For the purpose of additional security, cross walls are built between the arches, over which the rails are to lie for the trains, and the intervals are filled with concrete. By this means the mass is rendered one solid piece, and the weight of the carriages is spread over a large space.

We cannot but regret that little minds should have the power of impeding a work of this magnitude; yet so it is. One mighty means of interruption had been happily avoided, by preventing meetings of the subscribers from confusing and marring the plans of the directors. It was owing to this judicious arrangement that the work proceeded so rapidly, that 422 arches reared their heads within the first year, from April the 4th, 1834, to April the

* Lest my friend Sir John Rennie should again hazard an expression that I am "unacquainted with the engineering details," I must here beg to observe, that a few of the piers on each side of the abutments supporting the elliptic arch over Earl's sewer, nod a little towards the sewer, from a circumstance of which it is unnecessary to go into the "engineering details," but I will if Sir John wishes it.

4th, 1835. But, unfortunately, the Act empowers certain local committees to receive and judge of, or rather to chatter over and retard, for probably, poor fellows, this is all they can do, the engineer's plans for passing the several roads. Thus it is that we see the works brought up to and standing here and there at a road, the deliberating committees not having decided whether the engineer shall pass them by arches of brick, or, I suppose, of air, with locomotive-engines or balloons. Were it not for these frivolous delays, I am informed that within five or six months the road would be opened from Deptford to London, and, of course, making returns to the shareholders.

It seems to be a favourite maxim with Colonel Landmann, the engineer, that wherever the lead is long, a viaduct is generally more economical than an embankment. Without implicitly subscribing to this doctrine, in which there is often more truth than some civil engineers are willing to admit, it is evident that embankment in the Greenwich Railway would have been little short of insanity. Putting out of the question the enormous expense of forming it where all the materials have to be raised to the embankment, not to be drawn out on a level, and of the additional ground to be purchased, both for the embankment and materials; setting, I repeat, all this aside, together with the immense rental which must ultimately result from near 1,000 manufactories, shops, houses, and warehouses, into which the arches are being converted, it is probable that long before such an embankment of 22 feet high could settle into a road fit for locomotive travelling, the Colonel's viaduct will be finished, and likely enough return a large portion of the capital expended.

At the Deptford end several of the arches are now occupied by the Company for smiths', carpenters', and other shops, which must obviously be a great saving to the concern. One or two of the arches are also tenanted as public-houses. Over two, made into two five-room private-houses, I have been, and I must confess, contrary to my expectations, I found them comfortable, roomy, and compact. The inconvenience I anticipated in my former communication from the smoke, is removed by the use of gas stoves, with which the houses are furnished. In the neighbourhood of London many of these arches will doubtless be let for offices, vaults, and warehouses. I have heard that 500*l*. per annum have already been offered for some between Joiner-street and the Bridge terminus. At all events, it will be the managers' fault if ultimately they do not turn in a large revenue. It is said there will be about 1,000 of them, which some calculate will fetch 30*l*. per annum each; or, on the whole, a rental of near 30,000*l*. per annum. But suppose only 900 of them let, and at 20*l*. each, the rental will be 18,000*l*. per annum, or 2,000*l*. annually more than the interest of the whole capital (400,000*l*.) at 4 per cent.; a tolerable argument that the engineer had here good reason for preferring his viaduct to a profitless embankment.

There is an objection to the external fitting up of the houses, which, trifling as it may appear, I cannot help noticing, as disadvantageous to their letting. The fronts of those I have seen are with compo made to appear square, which detracts from their height, and gives them somewhat of a mean appearance. Had the arched fronts have been preserved, it would have been much more characteristic, and I conceive considerably more tasty and attractive.

Again, there is another fault, or rather an oversight, that I am surprised has been committed. The distance to Greenwich by the railway is said to be 3¾ miles; and by the road, 5½ miles. A saving, therefore, of near 2 miles in 6 is effected. The projector, of course, instantly caught at this, and considered that a road for private carriages so materially abbreviating the distance and escaping the turnpikes, and a path for pedestrians with a trifling toll, could not fail to be a source of great profit. No doubt he is right. But the error I allude to is this:—The footpath is on the ground, and goes through an unvaried, monotonous track; whereas had it been raised, supported by brackets or otherwise, to a level with the railway, or 22 feet higher, the prospect would be extremely rich and attractive. What would have been the consequence but the making of it a favourite and fashionable promenade? And it might reasonably be expected that for every

person who goes on it for business, ten would for pleasure or health. Of course, the revenue would increase in proportion; at least, if 2 or 2½ per cent. on the capital, as now calculated, be a fair estimate, five times as much, or 10 per cent., might then fairly be expected.

One of the most valuable features of this design is that of its coming so completely into the metropolis as London Bridge is. It was no doubt artfully projected to monopolise all railroads from the east and south-east of London, and in that must be successful. A Bill for a railroad to Croydon, for instance, joining the Greenwich about 2½ miles from London, has already passed the Legislature. And if the Croydon should send an arm into Mr. Cundy's Brighton line, which is contemplated, it will add materially to the traffic, and, of course, to the profits of the Greenwich line. For let it be observed, whether the Croydon and Brighton lines pay or not of themselves, their contributions to the Greenwich shareholders, being in the shape of tolls, will be nearly all profit. Again, a line is projected from Greenwich to Gravesend; and others are talked of from Gravesend to Rochester, Maidstone, Dover, &c. Now, whatever be the fate of these railways, when formed they will all be so many tributary streams of profit to the Greenwich. Thus, without considering its own traffic, which will doubtless be very great, the Greenwich line, like the trunk of a tree, must gather strength and bulk from every branch it sends forth.

What may be the profits from these sources it is no easy matter to estimate accurately, and I should be exceedingly sorry to mislead. But as my purpose is to inquire into these extraneous profits for an object which will presently be seen, I shall take that view which I think will furnish results rather within than without the truth. It is obvious, as I hinted before, that whatever these branch-lines pay to the Greenwich will be a toll, that is, a certain part of their gross revenue; as, for instance, the Croydon Company, in regard to persons, are to pay *3d.** per head for the 2½ miles distance. Moreover, the London end being by far the most expensive part of any line, the Greenwich Company will, I have no doubt, take care to mind that in their dealings with other Companies, and therefore charge higher than in proportion to the mileage. Now, the Brighton gross annual revenue is calculated, in round numbers, at 500,000*l.* Let us suppose a half of it comes by way of Croydon, and the other goes in at the west end of the town. Then a $\frac{1}{25}$th of 250,000*l.*, which is a less proportion than it ought to be for 2½ miles on the Greenwich, gives 10,000*l.*, or 2½ per cent. on the Greenwich capital for the Brighton Company's toll, exclusive of Croydon. Again, the Gravesend compute their gross returns at 120,000*l.*, and they run 4 miles out of 21 on the Greenwich line. We may fairly, therefore, call their quota a ⅙th, or 20,000*l.* per annum, that is, 5 per cent. more. What the Croydon, Rochester, Maidstone, and Dover revenues are, I do not know, but we may very reasonably put them at another 5 per cent. Thus, then, the annual returns from the branch-lines will be 12½ per cent., for all of which the Greenwich Company will only have to keep the railway in repair, that is, on such a line, a mere bagatelle, if the rails are once laid down well and sufficiently strong. If to all this we add 4 per cent. for the rental of the arches, with 10 per cent., as I have shown before, which they might have if they will manage the foot-path well, and 2 per cent., which is less than they calculate for the carriage-road on the north side, we shall obtain no less than 28 per cent. per annum, which this Company are likely to draw from the public without even their using their own line, and with scarcely any counterbalancing expense. Can any one suppose that the projectors of the scheme were not alive to this, and widely awake to their own interest, however little they may have said to the public?

It will be observed, that I have omitted the expense of locomotive-power. The fact is, it is hardly worth noticing in so rough a calculation of per centages. For if the locomotive-power on the Darlington is contracted for at ⅖ths of a penny per ton per mile, it would be very trifling in persons, when about 14 go to the ton; and therefore in the per centage, even throwing goods and persons together, it would be an insignificant fraction.

* My information, I think, can here be scarcely correct. For this is only 1¼*d.* per person per mile, while the Birmingham and Southampton Companies are permitted to charge for the use of their lines 2*d.*, or 60 per cent more.

Beneficial as this concern will, in all probability, turn out to the shareholders, I question whether it will not be the parent of many ruinous speculations; and it is to prevent this, as much as lies in my power, that I have now entered into its peculiarities. For when adventurers hear of a division of profits of perhaps 35, 40, or 50 per cent. from a scheme which was allowed to slide through Parliament because it was thought too eminently absurd to deserve opposition, they will not fail to use it, for working on the credulity of those who may not be acquainted with the singular circumstances which give such advantages to this line. Where, for example, will again be found a line whose embankment alone may produce a rent-roll more than sufficient to defray the whole interest of the capital? Where again could another line be projected, between such a place as London and a couple of villages within so short a distance, whose united population exceeds that of many cities, starting too from the heart of the capital, and traversing a beautiful country, with a saving of one-third of the distance? Lastly, where could another case occur in which a line, from foreign resources alone without any dependence on its own, and without even the least exertion, may reasonably expect to reap an income two or three times the fair interest of its capital? If a parallel case cannot be found, it is to be hoped this Greenwich line will not be made a subject of comparison, nor turned into a decoy-bird for other speculations.

JOHN HERAPATH.

Kensington, Sept. 1835.

FURTHER EXPERIMENTS ON INDIGO.

Sir,—The action of sulphuric acid on indigo was very incorrectly described by the older chemists. In the year 1776, Bergman observed that when indigo in powder was sprinkled upon concentrated oil of vitriol, sulphurous vapours were evolved, clouds of a green colour formed in the liquor, and at the same time great heat produced. Berthollet, in his excellent work on Dyeing (Hamilton's translation, vol. ii. p. 66), considers the change which takes place to be caused by a species of combustion, the acid furnishing the indigo with oxygen. Dr. Bancroft conceived the solution to be oxygenated indigo in combination with sulphuric acid, the acid becoming first yellow and then green, owing to the union of part of the oxygen of the indigo with part of its hydrogen determining the formation of water; he supposed that when it is thereby rendered soluble, it enters into a triple combination with the oxygen and sulphur composing the acid, regaining its blue colour with additional brightness either from its union with an increased proportion of oxygen, or from some effect resulting from the sulphur which had not been combined with it originally. Dr. Bancroft also observed, that after being dissolved by sulphuric acid, the indigo can never be restored to its original state; he, therefore, calls the whole sulphate of indigo. This was all that was known on the subject when Mr. Crum commenced his researches, which may be found in the *Philosophical Transactions* for January, 1823. Having carefully repeated his experiments, together with the more recent ones of Berzelius, and having made a few observations myself on the various attendant phenomena, I propose to lay them before your readers.

It is only when impure indigo is employed that sulphurous acid is generated during the solution of that substance in sulphuric acid with either precipitated or sublimed indigo; although there is probably a decomposition of the acid, there is no indication of it; heat is invariably produced, and I think it is pretty evident that water is formed, and that the oxygen and hydrogen gases are furnished by the indigo, because the blue colour is always restored by the addition of water. The indigo during solution undergoes a change, which is more or less complete, according to the time the substances are left together and the degree of temperature to which they are exposed. In about 24 hours, at the ordinary heat of summer, the indigo is converted into a new substance, for which Mr. Crum has proposed the name of *cerulin*.

To produce cerulin, I digested precipitated indigo for six hours in very highly concentrated sulphuric acid, and then poured the thick blue liquor into distilled water, sulphate of potash* precipitated a dark blue substance, which was thrown on a filter, and washed with a solution of

* Potash itself and some other neutral salts have the same effect.

acetate of potash,* and subsequently with alcohol; while wet, the new substance had a dark blue colour, but when dry it was copper colour. Mr. Crum calls it cæruleo-sulphate of potash. When a portion was burnt, no purple fumes were formed, but a considerable quantity of ashes remained; it was highly deliquescent, 3 grains acquired in 5 hours, by exposure to the air, nearly $\frac{1}{4}$th of a grain in weight. I made a great many experiments to ascertain by what salts it was precipitated when dissolved in water, the solution being of such a strength that a candle appeared when viewed through it in a test-tube of a purple colour; the results were as follows:—

Prussiate of potash, Acetate — do., Carbonate — do., Nitrate — do., Sulphate — do., Tartrate — do., Muriate — do., Iodide of potassium — blue.

Muriate of soda, Carbonate of soda — blue.
Borate of soda, Phosphate of soda — no change.
Muriate of ammonia—no change.
Nitrate of ammonia—blue.

Nitrate of barytes—blue.
Nitrate of silver—liquor turned mouse colour, but no precipitate.
Nitrate of mercury, Acetate of lead, Nitrate of strontia — blue.
Solution of gold—colour destroyed.

Muriate of iron, Sulphate of iron — no change.
Nitrate of copper, Sulphate of copper — no precipitate, but one drop of a solution of either caused the flame of the candle to appear blue.

Sulphate of magnesia, Sulphate of zinc — no change.
Muriate of lime—blue.

All these blue precipitates appeared to be the same; being dissolved in sulphuric and boiling muriatic acids, forming fine blue solutions—and forming colourless solutions with nitric acid. Mr. Crum supposes cerulin to be a compound of 1 indigo + 4 water.

At the commencement of the solution of indigo in sulphuric acid there is produced a purple liquid, and if the action of the acid is stopped before cerulin is formed, this purple may be insulated, and obtained in a separate state. If that acid prepared from the dry proto-sulphate of iron, and called after the place at which it is made, Nordhausen acid, is used, the dilution with water must be made immediately after solution, but with the common acid† it requires two or three hours for its formation; if, however, heat is employed, ten minutes is sufficient. After the dilution the whole must be thrown on a filter, a blue liquid passes through, and indigo-purple remains; this is washed with distilled water till the blue colour is extracted, and from this the indigo that has been changed may be precipitated by muriate of potash, and subsequently washed with distilled water till the washings cease to form a white cloud with nitrate of silver. The substance remaining on the filter Mr. Crum calls phenicin, from the Greek *φοινιξ*, *purple*; like cerulin, the solution in water is blue, but it is

* Mr. Crum ascertained that cerulin is not soluble in any salt of potash, although it is almost to any extent in hot water; he recommends the acetate as possessing the advantage over the muriate or sulphate of not being precipitated by alcohol from a weak solution in water as they are. It may consequently be afterwards removed by washings with alcohol.—See note DD to the 2d volume of Ure's Translation of Berthollet on Dyeing.

† Since it is of importance in all experiments of research to employ pure materials, it is advisable to purify the sulphuric acid used in these experiments, by diluting it with an equal weight of distilled water, and allowing it to stand till perfectly clear, afterwards evaporating in a glass retort containing pieces of platina (to prevent it from breaking), till of the strength required; by this means the sulphate of lead, which exists in considerable quantities in commercial sulphuric acid, may be completely separated.

sparingly soluble; it was precipitated by every salt I tried. It is turned green by caustic alkalies, in which it seems to resemble syrup of violets; by standing, however, the green colour soon vanished, and a purple powder slowly collected. Mr. Crum considers it to be a compound of 1 indigo + 2 water.

I shall now describe the experiments of Berzelius, by which it will appear that he takes a different view of the subject. I have repeated and varied them, and come to conclusions somewhat different from his. Berzelius remarks, that the action of sulphuric acid on indigo is attended by a decomposition more or less complete of the acid. Hypo-sulphuric he finds is formed, which has the property of uniting with organic matters, the latter acting as bases, and forming permanent compounds. Fuming sulphuric acid dissolves revived indigo rapidly, and without the disengagement of any sulphurous acid; six parts by weight are sufficient for one of indigo, but of common acid one half more is required. The solution, says Berzelius, contains, 1st, indigo-purple, 2d, sulphate of indigo, and 3d, hypo-sulphate of indigo. He thinks it probable that the hypo-sulphuric acid may have been formed by the decomposition of a portion of the indigo, which at the same time has given origin to a new purple substance (pourpre d'indigo). The more fuming the acid, the greater the quantity of hypo-sulphuric acid produced. The best method of procuring these two acids, viz. the indigo-sulphuric and indigo-hypo-sulphuric, for examination, is first to separate the phenicin by the method described, and then to immerse pieces of clean flannel or wool into the blue acid solution till the colour is nearly extracted (it will be found impossible to absorb the whole of the colour, probably owing to the presence of a small quantity of phenicin); the pieces of flannel are then to be well rinsed in distilled water till all the adhering acid is removed, and then digested, taking care not to allow the heat to rise higher than 140° Fahr. In water, holding in solution a small quantity of carbonate of ammonia, the colour will be transferred by this means from the flannel to the water, which Berzelius supposes now to contain indigo-sulphate and indigo-hypo-sulphate of ammonia. The next step of the operation is to evaporate to dryness, which must be done with a considerable degree of caution, never allowing the heat to rise higher than 135°, or 140° at the most: this, although it renders the process extremely tedious, is absolutely necessary; when quite dry alcohol is poured on it, which, according to Berzelius, takes up the blue *hypo*-sulphate of ammonia, but leaves the blue sulphate of the same base untouched; the latter is dissolved by water, and decomposed by acetate of lead and the resulting salt. Indigo-sulphate of lead is again decomposed by hydro-sulphuric acid, thrown on a filter, through which drops a liquid, at first yellow, owing to the deoxidising power of the hydro-sulphuric acid, but rapidly becoming of a beautiful blue colour. On evaporating this to dryness, a dark blue substance remains, having a very acid astringent taste—it is indigo-sulphuric acid.

Indigo-sulphuric acid is an extremely deliquescent substance, almost as much so as chloride of calcium; it is, of course, very soluble in water, and forms with alkalies a class of salts quite distinct from those formed by the hypo-sulphuric acid. I neutralised three small quantities with potash, soda, and ammonia; from the two first a dark blue precipitation fell, the last remained clear. The indigo-sulphates of potash and soda, I found, contrary to the statement of Berzelius, to be very soluble in water, and not altered by either sulphuric or muriatic acid. I am decidedly of the opinion that when highly concentrated sulphuric acid is employed, there is *no hypo-sulphuric acid produced*; but when it partakes in the least degree of the character of a fuming acid, the production of that acid is considerable, for when a small quantity of sulphur was boiled in the acid I had used in all my experiments, alcohol became of a dark blue when poured on the dry residuum at the proper stage of the process, and acetate of lead dissolved in alcohol, threw down a blue substance, which subsequent experiments proved to be indigo-hypo-sulphate of lead. I must observe, that I do not wish to oppose my opinions to those of so eminent a chemist as Berzelius; I have merely stated the facts as they presented themselves to me, and I lay them before the public to decide where the error (if there is an error) lies, and shall be thankful to any one who

will take the trouble through the medium of your Magazine to point them out.

I am, Sir,
Your obedient servant,

W.

Bath, September 7, 1835.

ON FIRE-PROOF BUILDINGS. BY MR. CHRISTOPHER DAVY, ARCHITECT.

(In continuation from p. 398.)

The Committee appointed by the "Associated Architects" (mentioned in my last communication), having received several plans and suggestions, agreed to institute an extensive series of experiments, more particularly according to three plans proposed by Lord Mahon (afterwards Earl of Stanhope), Mr. David Hartley, and Mr. Wood. So confident was one of the Committee, the late Mr. Holland, the celebrated architect, of the security that might be obtained by the adoption of these plans, that he freely and gratuitously granted the use of two new houses for the purpose of putting them to the test.

From a striking defect in the Report of the Committee, no account of Mr. Wood's composition is given, although the experiments made with it were numerous and satisfactory. The methods of prevention proposed by Mr. Hartley and Lord Stanhope, were considered to be quite effectual; that by Mr. Wood, less so, but very serviceable, especially at the back of wainscot linings, &c. Mr. Hartley's plates were found to be much less liable to injury than Lord Stanhope's composition, which, as it is necessary it should be quite dry before the boards are laid, must be guarded from accident in the interim. But if Lord Stanhope's method is strengthened by a gauge of plaster or quick lime, there will be little to apprehend. Arches of cones,* or bricks, or tiles, used instead of plates or plaster, will answer the purpose, but they are more weighty and expensive.

The preventive method proposed by Mr. Hartley is thus described in an Act of the 17th Geo. III., entitled, "An act for vesting in him and his heirs the means of prevention, described in the following terms: — "My invention of securing buildings and ships against the calamities of fire is described in the manner following—that is to say, by application of plates of metal and wire, *varnished* (?) or unvarnished, to the several parts of buildings or ships, so as to prevent the access of fire and current of air, securing the several joints by doubling, overlapping, *soldering*, (?) rivetting, or in any other manner closing them up, nailing, screwing, sewing, or in any other manner fastening the said plates of metal into and about the several parts of buildings and ships, as the case may require."

The method of applying Mr. Hartley's plates is as follows:—

Garret Story.—Above the ceiling-joists, against the rafters, down to the flooring-joists of the garret floor—namely, immediately under the boards; home to the party-wall and home to the front and back walls; turned up against the plates of the partitions and against the walls two inches; and a flashing let into the wall and turned down.

All the Floors in the several stories to be secured in the same manner.

To secure Wooden Staircases.—The fire-plates must be placed upon the rough steps and risers, in such a manner, that the finished step and riser may be set close upon them.

Mr. Hartley's experiments were made at a house, No. 10, Hans' Place, secured according to his directions.

Experiment 1.—*August* 2, 1792.

A fierce fire was lighted in two chimneys in the basement story; one of them having in it a wooden-box, secured with the fire-plates, and the other having a box also, but not secured. The fire having continued for one hour, was extinguished. The inside boarding of the secured box was burnt and left the plates bare, and supported by the quarters, which quarters remained good; one of the joists under the bottom was partly burnt. The unsecured box in the other chimney was totally demolished in forty minutes.

Experiment 2.

A fierce fire was lighted on the floor in the back garret, and against the ashler-

* A sort of pottery, made by Mr. Morris, at Child's Hill, near London. In my account of the New Buckingham Palace (vol. ix. p. 354), your readers will find these "cones" mentioned, and in a subsequent communication described. During the extensive street improvements in the reign of the late King, this invention was introduced, and has been since that period extensively adopted in our public buildings.

ing; both of which had been secured. (The ceiling underneath was not laid.) This fire was extinguished after the space of one hour, at which time the flame had made its way through the boards, and taken hold of the joists underneath the plating. The flooring-boards were burnt away in the seat of the fire, leaving the plates quite bare; upon removing the plating, the foot of the ashlers and plates upon which they rested appeared charred about 12 inches up.

Experiment 3.

A rough staircase having been prepared and duly secured, a fire was lighted upon the winders, and extinguished at the end of thirty minutes. At this time the treads and risers appeared charred, and one riser burnt entirely through under the tread of one of the winders. A small corner of the rough tread underneath the plating appeared charred.

Experiment 4.—*October* 4, 1792.

At ten minutes past two o'clock a fierce fire was lighted in the second story back room on the floor and in the angle against the partitions, which separated the room, both rooms having been previously secured. In the course of a quarter of an hour from the commencement of the fire, the skirting was burnt, and the flame extended itself through the lath and plaster, and took hold of the foot of one of the quarters, which was in a short time consumed twelve inches up. At five minutes past three o'clock (being three quarters of an hour), the smoke appeared through the plates underneath the flooring. At twenty minutes past three o'clock (being an hour and ten minutes), the fire itself appeared through the flooring, and at half-past three took hold of a joist, but did not continue its course long.

It appeared clearly from the experiments that the plating will effectually prevent all fires extending itself to any material distance.

C. Davy, Architect.

3, Furnival's-inn, Sept. 2, 1835.

(To be continued.)

VENTILATION OF STAGE-COACHES.

Sir,—Permit me to offer to the public, through the medium of your widely-extended Magazine, a hint or two from an old traveller, on the subject of stage-coach ventilation. Many others as well as myself have doubtless been annoyed by the *aerophobia* of many who travel by our public carriages, and the pertinacity of such persons in keeping the windows closed for fear, as they say, of catching cold. Such persons have yet to learn that colds are more frequently the consequence of closely-confined air in a badly ventilated apartment, than by free exposure to the wind and weather. Some people seem to regard fresh air as poison, and do all in their power to exclude it; for my own part, I think it is the only one of the numerous blessings of Providence that cannot be taken to excess.

The mode of ventilation I would suggest, is simply this, that the sashes of mails and other stage-coaches, instead of being glazed, as at present—the panel formed by a pane of glass—should be made with wire-gauze, such as is now extensively in use for window-blinds. The vehicle would by this means be amply ventilated without annoyance to any one by currents of air; and, in case of rain, the sashes might be kept up without the choice of evils at present experienced, either to be wet through or suffocated.

An Old Traveller.

JOURNEY FROM LONDON TO BIRMINGHAM IN ONE OF MR. HANCOCK'S STEAM-CARRIAGES.

The London and Birmingham Steam-Coach Company, on Friday, August 28, started one of Mr. Walter Hancock's steam-carriages, in order to ascertain the power required for running steam-carriages (for carrying passengers) on the turnpike-road between the above-mentioned places; and also for the purpose of building carriages for the aforesaid line of road. The trips were made to the following towns, where the Commissioners of the several Trusts were assembled to view its performance, namely, Redbourn, Brickhill, Dunstable, Daventry, Coventry, and Birmingham. These experiments pointed out that an engine of greater power was required between London and Dunstable than would be necessary between Dunstable and Daventry, arising from the nature of the soil, and the materials of which the roads were composed; showing that a level road of inferior materials is more injurious to draught than a hilly road formed

of good stone, and properly constructed. The greatest obstacles the carriage met with were—Ridge Hill and River Hill, between London and Dunstable—Hockcliff Hill, Denbigh Hall Hill, and Weedon Hill, between Dunstable and Daventry—and on the third station, between Daventry and Birmingham, the ascent at Ryton Tollgate, and the entrance to the town of Birmingham. The engine with which these experiments were made, was built for short runs and a level road; and having performed the distance between London and Birmingham at the rate of ten miles an hour, it clearly demonstrates that engines of the same weight, and possessing double power, (of which one or two are now built,) will maintain a speed of from 14 to 15 miles an hour, throughout the journey. These carriages are intended to carry about 25 passengers each; the fares inside not to exceed 1*l.*, and outside 10*s.* It is expected the arrangements will be completed and the carriages ready to start by the beginning of March, 1836. The manner in which the carriage was received by the numerous crowds of people on the road was truly gratifying. We hear that it is the intention of the Company to employ the present coachmen and guards as directors of the steam-carriages.—*Coventry Mercury.*

MR. M'CURDY'S DUPLEX GENERATOR AND THE BOILERS OF MR. OGLE AND COLONEL MACERONE.

Sir,—In your last, (No. 629), N. D. C. has really insulted the senses and understandings of your readers, by comparing M'Curdy's "duplex generator," composed of hollow cylinders, inside of each of which is inserted another hollow cylinder CLOSED AT BOTH ENDS, &c. &c., to Mr. Ogle's boiler of double, upright cylinders, *open at each end for the free passage of the fire through the centre of the water contained in each!* It is not necessary to say a word as to the utter blindness of the comparison; a printer's index (☞) to the drawings of the two, which, unluckily for N. D. C., happen to be both in the same Number (629), will suffice for any one who hath eyes in his head.

Mr. Ogle, I see, talks, in your last Number, of steaming it "over the Alps." *He* does not "boast" or "whine!" *He* only says what he could and would do, would people but *give him money!* *My* having scrupulously abstained from saying a word about *my* doings, save and except by republishing *verbatim* the published reports of *others*—disinterested public men—is called "puffing and boasting!"* *I* am "the only boaster!" Be it so. I am not ashamed of *such* boasting! Let others show the like! But more of this anon, in the second edition of my last pamphlet. "Let the galled jade wince."

Your obedient servant,
F. MACERONE.

ELECTRO-MAGNETIC MOVING POWER.

British Association.—Section of Mathematics and General Physics.

The Rev. Mr. M'Gauley exhibited the working model of a machine for producing moving power by the application of electro-magnetic influence. The model consisted of a pendulum, the lower part of which was a magnet placed with its poles opposite to the ends of two horse-shoe bars of soft iron, round which were coiled helices of wire so arranged that by the end of the helices dipping into cups of mercury the poles of a simple galvanic battery could be alternately made to communicate with the cups in one order, and the next instant the machine reversed that order by means of a system of bent wires, caused to vibrate upon an axis, the ends of these bent wires alternately dipping into one pair of cups, and the next vibration into another; by these means the soft iron horse-shoes are at one instant a magnet with the poles in one order, the pendulum being then attracted towards both these poles, but the next instant, the poles being reversed, the pendulum is thrown forcibly back, while the opposite soft iron horse-shoe is now a magnet ready to attract it; then again it is thrown back from this second temporary magnet by the instantaneous reversing of its poles, and so on. The model worked smoothly and with a very uniform regulated motion, and appeared to be capable of working for a great length of time. Mr. M'Gauley stated that the erosion of the zinc plate was so inconsiderable, that there was hardly any limit to the length of time that the model would continue working. The acid best suited to the purpose was a

* The 1700-miles without-a-shilling-for-repair story—whose was that?—ED. M. M.

mixture of one part nitric acid, two parts sulphuric, and one hundred water; he also stated that the acid in practice could be always renewed by having a constant dropping of fresh acid liquor into the trough, while a similarly gentle discharge of the spent acid from the trough could be kept up. He stated, that a numerical comparison of the economy of this mode of producing motive power with that depending upon the agency of steam, would give a vast preponderance in favour of this method, while the part of the power consumed in working the machine itself might be left entirely out of account, since the apparatus which changed the poles in his model, would equally suffice in a machine capable of working with the power of one hundred horses. In his model he only worked one of the two soft iron magnets, and its power was only that of lifting seven pounds, and yet this appeared to be sufficient to overcome all the friction, inertia, and other impediments to motion, of the several parts of the machine.

The exhibition of this model was received with sincere and reiterated applause, and many scientific men present expressed sanguine expectations of the value of the method in a practical point of view, all agreeing that it was the best attempt yet made of the many schemes that had been proposed for producing motive power by the electro-magnet.—*Athenæum.*

MR. HALL'S STEAM-ENGINE IMPROVEMENTS.

Sir,—Although it is long since I expressed my opinions on this subject, I trust I shall not be considered either out of time or place in again recurring to a "matter (as you truly say) confessedly of some public importance."

No sooner was my first letter (commencing with the truism, "that in these days of quackery, extraordinary announcements are most certain to create suspicion"—see p. 156, vol. xviii.) before the public, than I was most unmercifully attacked by Mr. Hall—no, I ask pardon, not by Mr. Hall (for, by the advice of his professional and confidential friend, Mr. A. Rosser,* p. 278, last volume, he has long since determined never to appear in a controversy on the subject of his own inventions), but by the *un*presuming "Audax," and his coadjutor, Mr. J. Ride.

In 1832, Mr. Hall, be it remembered, published a particular and detailed account of "the five parts of his invention, all mutually assisting each other, and constituting a perfect whole;" which perfection, it was stated, was, and could only be obtained by his "particular mode of using metallic surfaces," viz. "by keeping them full of the water resulting from the condensation of the steam, which becomes the internal condensing water," for want of which, all previous attempts to attain this desideratum had proved abortive. All this was strenuously upheld and insisted upon by "Audax" and Mr. J. Ride; the latter even went a step further, and vouched for it as the "great principle," which, in fact, formed "the substratum of the whole invention." I should think there is not one among your innumerable readers, who, having witnessed the contumely with which I was treated in vol. xviii.—particularly for saying that the water confined in the refrigerating pipes, by means of the caps, could be of no other use than to reduce their "sectional area"—I say, no one could possibly imagine, that that hint should have been made the basis of Mr. Hall's last patented improvements, the most prominent feature of which *improvement on perfection itself*, consists of getting rid of the internal condensing water by doing away with the wonder-working caps, and fixing the pipes vertically instead of horizontally, and, finally, by reducing them to about $\frac{4}{5}$ths of their original "*sectional area!!*" Thus at once upsetting *in toto* that most beautiful and scientific "great principle," "the substratum of the whole invention."

Again, in the item of fuel Mr. Hall first stated the saving to amount to *two-thirds*, but how stand his testimonials? "Audax" does not mention any saving. Mr. J. Ride would have said a great deal, but was forced to acknowledge he knew nothing about it. Mr. J. Wright says, that on board the *Prince Llewellyn*

* Had it not been for the P. S. to this gentleman's letter, I should never have believed it possible, that the liberal-minded advocate, and great champion of the emancipation of the junior class of chimney-sweepers, could give publicity to such illiberal sentiments, which, if carried into effect, must clap the padlock on the minds of more than half your correspondents.

he "can fully testify the saving is fully *one-third* of the fuel *formerly consumed.*" Captain K. B. Martin's statement is still more vague—"he is convinced that in smooth water, &c., the vessel is *rather* faster, and the saving of fuel is *about a ton per average passage.*" Messrs. Lloyd and Kingston, in their Report to the Lords' Commissioners of the Admiralty, say not one word of any saving in fuel, but give it as their opinion that "the power of the engines is not *diminished;*" the total silence of these gentlemen as to fuel may perhaps in some measure be accounted for by an experiment which I have heard confidently spoken of, wherein the saving amounted, not to upwards of 60, as at first stated by Mr. Hall, nor to 30, as fully testified by Mr. J. Wright, nor yet to either 20, 10, or 5, but positively to no more than 2½ per cent.!!!

The following is an extract from the evidence given by J. Field, Esq., before the Select Committee on Steam Navigation to India, p. 253:—

"886. Are you aware of the improvement introduced into some steam-vessels, to condense the steam in the pipes, without admitting the jet of water into the aperture?—I am.

"888. Do you think it likely that this will be brought to *perfection?* I do not know; IF IT SUCCEEDS, it will be a very great advantage."

To appreciate justly the value of this evidence to the public at large, it must be remembered, that Maudsley and Field stand first on Mr. Hall's list of "eminent engineers," who, "having fully investigated the matter," have taken licenses under the patent.

Surely, Mr. Editor, there never was such vague, negative, and inconclusive evidence before published in support of an invention with such extraordinary pretensions.

I remain, Sir, very respectfully yours,
T. V. ROBSON.

Sept. 3, 1835.

MR. GALT'S SUBSTITUTE FOR STEAM-POWER.

Sir,—Seeing in your last Number, under the title of "Substitute for Steam-Power," a plan by which Mr. Galt proposes to avail himself of the power of a Bramah's hydrostatic-press in producing motion, I am induced to trouble you with a few remarks on the subject, the same idea having occurred to myself not many days previously to my seeing the article on the subject, but which, on consideration, I believe not to be applicable.

It is evident that if a cylinder, in which a piston is made to move air-tight, and the upper surface of which is exposed to the atmosphere, be filled with water so as to exclude all the air, and that then this water be allowed to escape by an orifice at the bottom, a vacuum will be produced beneath the piston, which consequently will be pressed down with a force proportionate to the surface exposed. Here, then, we would seem to have a determinate moving-power, but it is evident that the motion produced would be but slow, as it would require a certain time for the water to escape even from a considerable orifice. Mr. Galt proposes, if I mistake not, that this motion be applied to work a forcing-pump, or some other contrivance by which a certain quantity of water is to be raised so as to exert a pressure on the bottom of the piston in the large cylinder, as soon as it has reached the bottom, and thus raise it; but here comes the difficulty. The power of Bramah's hydrostatic-press is known to depend on the relative diameters of the two pistons. Suppose the piston in the large cylinder to be one foot in diameter, and that of the forcing-pump to be half an inch, then the pressure of the water on the bottom of the large piston will be to the pressure of the smaller piston as a square foot to a quarter of a square inch (the areas of circles being as the squares of their diameters), that is, as 144 square inches to ¼th of a square inch, or as 576 to 1; and, therefore, if the pressure of 1 lb. weight be given to the water in the forcing-pump by means of its piston, the larger piston will be moved upwards with a force of 576lbs.; hence the smallest given quantity of a fluid may be made to produce an unlimited pressure, either by diminishing the diameter of the column, and increasing its height, or by increasing the surface which supports the weight: but it is evident that the motion produced by such pressure upon the piston in the large cylinder will be but through an indefinitely short space, as it would require a column of water in the small cylinder of the forcing-pump to be raised to a prodigious height in order to equal the contents of the larger cylinder; consequently,

the length of stroke of the large piston must be very short, while that of the small piston must be a proportionately long one. The impelling power produced, in the first instance, by the descent of the large piston, must act, then, at a great mechanical disadvantage in raising the weight at the end of a long lever, by means of a power at the end of a very short one; and here, I conceive, that instead of motion being produced, there would, on the contrary, be an equilibrium between the weight and power.

Such was the view that I had taken of this subject before I saw the article in your last Number. I may be mistaken in that view, and if so, should be glad to be corrected. If the object could be attained of applying the power of the hydrostatic-press in producing an effective moving-power, it would certainly be a most important addition to the present state of mechanical knowledge.

Should these remarks appear to you to be worthy of insertion,

You will oblige, &c.,

HYDRAULICUS.

Sept. 2, 1835.

P. S.—Mr. Galt, in the article I allude to, mentions the application of his *pressure-syphon* to the propelling of vessels. Not being acquainted with the principle of this machine, I should feel particularly obliged to you, or to any of your correspondents, to explain it in a subsequent number of your valuable Magazine.

PERKINS'S HOT-WATER HEATING SYSTEM.

[We copy the following judicious remarks from an article in the last Number of the *Architect. Mag.*, on the "Comparative Advantages and Disadvantages of the various Hot-Water Systems." The author lays it down as a general rule, which he supports by many cogent arguments, that the hot-water system, now so much in vogue, is only properly applied where great uniformity of temperature is important, and where, at the same time, ventilation or change of the mass of the air heated is unnecessary, and rapidity in increasing the temperature, is not required. He objects, therefore, altogether to its use in airing rooms, churches, theatres, &c.—ED. M. M.]

The advantages attributed to this mode of warming by hot water may, I think, be reduced to the following:—that, by closing the apparatus altogether, the temperature of the included water may be raised to any required amount; that, therefore, in proportion as the temperature of the surface of the tubes is higher, their superficies may be diminished, and that this will enable tubes so small to be used, that they can be bent, accommodated, and placed in situations where large ones would be impracticable; that the cost of the apparatus is thus much reduced; that no fresh supply of water is ever needed, and, therefore, no deposit of sediment can take place in the tubes; that the higher temperature enables the fire to be raised proportionably in intensity, and, therefore, to burn less to waste, or to a more advantageous use of fuel; and that less weight of water and apparatus is placed on the floors, &c. This, I think, is a pretty fair statement of all that can be reasonably alleged in favour of the pressure system. Let us now see how far the allegations are borne out. First, it will be advisable to see what increase of temperature we shall get, in proportion to the increase of pressure on the apparatus, over and above 212° Fahr.; accordingly, from Dulong and Arago's tables of elasticity and temperatures, the latest and probably most accurate that have been formed, we extract the following, omitting decimals:—

Atmospheres.	Temperature.
1	212° Fahr.
2	250
3	275
4	293
5	307
6	320
7	331
8	341
9	350
10	358
20	418
30	457
40	486
50	510

From this we perceive, that, to increase the temperature of the included water in the tubes, only one-half more than in any common open vessel, namely, to raise it from 212° to 318°, we must produce a pressure on every part of the surface of the apparatus of six atmospheres, or of ninety pounds, to the square inch, nearly; and that, to raise this temperature again by one-half, or to 477°, we must increase the pressure to nearly forty atmospheres, or to the enormous amount of six hundred pounds on the square inch.

To this latter temperature and pressure I believe Perkins's tubes never have been attempted to be raised, for the best of reasons, that they would not stand it: to the former they, perhaps, occasionally may. But, supposing that the temperature of the included water is actually doubled, or 424°, and, consequently, the surface of the pipe also doubled in heat; as the heating power of every body

that radiates is, *cæteris paribus*, directly as the temperature and surface of radiation, so here, the temperature being doubled, we may reduce the surface by one-half, and have the same heating power; in other words, the entire gain is, that the diameters of the pipes may be reduced by one-half. This, however, is not exactly the way in which the reduction is made; for the diameters of the pipes are kept always of the same dimension (about one inch), and the variation of surface is produced by lengthening or shortening them.

This, certainly, is no sufficient inducement for incurring the danger of having a network of tubes running in all directions about a building, charged with an intensely heated fluid, at so enormous a pressure. But the advocates of the system contend that there is no danger whatever, and that tubes, charged to six, eight, ten, or a dozen atmospheres, with water and highly elastic steam, are perfectly safe and innocuous; for that the tubes are proved, before they are used, to bear one thousand pounds to the square inch; that they are so small, that, even if burst, no danger can arise; that high-pressure steam will not scald, &c. &c.: all which, let those believe who can, I, for one, cannot; and I do not believe any twelve intelligent engineers (I do not mean hot-water engineers) can be found who will agree in a verdict of "safety."

To give my own particular notion, however, of why this mode of heating is unsafe:—The tubes used are what are called strong "rolled gas tubing," which is made of thin plate iron, with the edges united, without any lap, by pressure between the rolls, at a welding heat; and I never yet have seen a piece of it that would stand five hundred pounds to the inch, much less a thousand; to which latter amount I do not believe they are subjected, notwithstanding what is asserted; and any one who knows the difficulty of making and keeping in order a pump and valves, with other apparatus, &c., capable of forcing pipes to that pressure, will, probably, agree with me. Secondly, when gas-pipes burst, they almost always rip open at the usually imperfect weld, and that, too, for a good length; the result of which would be, in this case, that a gush of a fluid, half water and half steam, would rush out, and continue to do so until it had completely emptied the whole apparatus: and, supposing it were true that steam only made its way out, although, under certain circumstances, high-pressure steam will not scald close to the issuing orifice, yet when two, or three, or more feet distant from it, it will scald as well as the most vulgar steam in the world; but, in this case, it would be steam and hot water mixed, which, together, will scald, and scald horribly, at any distance from the issuing aperture within its range. Thirdly, it is apparently kept carefully in the back ground, that what is called the expanding-tube is usually one of about three inches in diameter, and, therefore, that it, which, from its size, is the most likely to burst, has no plea to put in on account of its small size. Farther, I should like to know how Mr. Perkins, or any of his deputed engineers, can tell to what amount of pressure they subject their tubes; for the only way it can be regulated, apparently, is so to apportion the cooling surface of the pipes to the surfaces receiving heat, that it shall, after a certain temperature, be carried off as fast as generated: but, even if this were accomplished, if the temperature of the air around the tubes rises or falls, or the fire burns better by change of fuel or weather, that moment the temperature of the included water rises with it, and the pressure increases likewise. So that there appears, thus, in principle, the utmost uncertainty, both in the application and management of the apparatus. In fact, I am inclined to believe that, in most cases, it is only a mode of heating by high-pressure steam, and that at no very great pressure either (care being taken that the coil in the fire shall not be able to burst the pipes), which goes by the title of "the patent hot-water apparatus."

I have not had much opportunity of observation of this system myself; but two facts I feel it most important to state, which I have on, I think, excellent authority; and, should it become necessary, I can give name and place for both cases and authority. First, the apparatus nominally called "hermetically sealed" is found almost, if not wholly impracticable to be kept so. The result is, that a small escape of steam at the joints, or at the top-feeding screw or air-screw (I know not what name the inventors give it), is continually taking place; so that, instead of its being never necessary to add fresh water, it is obliged to be poured in every twenty-four hours or so. Hence arises a very formidable consideration: every quart of water so added lays on a coat of sediment all over the inside (and especially over the parts in the fire) of the apparatus; and this coat of sediment is not deposited over a large boiler and large tubes, but confined to these the majority of which are only one inch in diameter; so that the first one-eighth of an inch in thickness, which is deposited in the pipes, will stop up about one-fourth of their area, and nearly destroy their power of conducting heat to the outside; and the second eighth in thickness will stop up a much greater proportion, and injure the conducting power to a greater amount also.

Now, the friction of the water in tubes of one inch diameter, and the immense resistance

occasioned by the vast number of bends and turns necessarily given to accumulate the required length of pipe into rooms, &c., is such, that I am strongly disposed to doubt whether, if a common apparatus of the sort were left open, and kept under the boiling point, the water would circulate in it otherwise than very languidly indeed; but when the bore comes to be reduced from one inch to three quarters of an inch, and from that to half an inch (for the second thickness will be laid on in much less time than the first), the friction would be so immense, and the heat given out so little, that the apparatus, before long, would be worse than useless. Time, as yet, has not been sufficient, probably, to develop this in any particular apparatus; but I am inclined to think it will be the fate and exit of many an one yet.

The other fact is this, and it is at once curious and important. One of the patent apparatuses had been at work some time successfully, when it ceased to give heat, and the pipes were found nearly cold, although the furnace was lighted. On examination, and taking out the top screw, the water was found to have wholly disappeared; and, on applying a lighted candle to the screw aperture, the tubes were found full of hydrogen-gas, which ignited at the aperture, and burnt away with a lambent flame.

There are but two ways to account for this: either the apparatus was not staunch, although "hermetically sealed," and the water had all boiled away, so that the tubes became red hot, and decomposed the last portions; or wrought iron possesses the property of decomposing water at a lower temperature, namely, at that due to the pressure on the apparatus; and if so, in every one that has ever been put up the water is thus slowly (perhaps I should rather say rapidly) decomposing, and thereby destroying the tubes. This, I confess, I think the most probable solution; and, if so, it is a confirmation of what has been predicted of the thing in the *Mechanics' Magazine*. Which ever horn of the dilemma is taken, it is cogent againt the apparatus, and adds formidably to the danger of bursting.

I must again repeat, that the recommendation given of them, that they are quickly heated, and hold little water, is, like in the case of the flat pipes, an argument against them, as they, also, cool quickly (although not so fast as the flat pipes), and, therefore, give no uniformity of heat.

Still, I freely admit that, for some purposes, where uniformity of heat is no object, they may be advantageously applied; but in those purposes I never could include heating the air of apartments; and, least of all, heating horticultural buildings.

COOKING BY GAS.

(From the *New York American*.)

This new application of gas seems to us of great promise for economy, comfort, and safety. We had heard nothing of it until a few evenings ago, on the invitation of Mr. L. Suydam,* President of the Manhattan Gas-Works, we had an opportunity, at his house, both of seeing the process of cooking, and verifying the fact, that what was thus cooked was "well done," even though not "quickly done."

The apparatus is of great simplicity. A circular or elliptical burner of such dimensions as may be needed—in a large family several of different dimensions would be required—is constructed, pierced with numerous and very small apertures, so that all the gas that passes may certainly be consumed. In the centre of the circle is a permanent perpendicular spit, on which the joint to be roasted is impelled, a sheet-iron funnel-shaped chimney, large enough at the bottom to include the lights, and tapering upwards so as to concentrate and reflect the heat, is then placed over the whole, and the cook may go about any other business for the next two or three hours, fully assured on coming back at the end of that time, of finding the meat well cooked. But this is not all. Over the funnel-shaped chimney is placed a large tin vessel, divided horizontally into two compartments—the lower one serving as a kettle to boil water, the upper as a vessel in which to boil meats or vegetables; and the same fire and the same time required for roasting will also suffice for boiling the water, and cooking the vegetables. The cost for fuel of such a fire as we saw, by which a 12lb. piece of beef was roasting, was stated by the superintendent, Mr. Barlow, at two cents an hour—or six cents for the whole period for cooking dinner—add to this the further economical advantage, that you only light your fire when you want it, and extinguish it the moment it has fulfilled its purpose, and we have a strong argument on the score of cheapness.

It is obvious that any number of these burners may be arranged—all to be supplied by one main leader—and as the cost of these fixtures is small, and only the gas actually used is paid for, it would be expedient always to have several of them.

Of course, the value of this new application of gas depends upon proper care in the use of the apparatus, and on the part of the Company, in the preparation and purification of the gas. As to the first, the whole thing is so simple, that except through wilfulness there could be no mistake; and as to the puri-

* The gentleman alluded to in Mr. Barlow's letter in the last Number of the Mechanics' Magazine. —ED. M. M.

fication of the gas, the interest of the Company would be so great in seeing to that, as upon its freedom from smell and brightness in burning, its general use would essentially depend—that little need be apprehended on that score.

NOTES AND NOTICES.

New Mode of Propelling Steam-Boats.—Dr. Planton, of Philadelphia, is now exhibiting in New York a model of his method of propelling steam-boats. The principle is the propulsion of boats by means of water-tight cylinders furnished with paddles. One of these cylinders is placed at each end of the boat, and acting both as buoyancers and propellers, they effect, as the inventor very satisfactorily demonstrates, the important office of impelling the boat over the surface of the water, without having to overcome the great resistance encountered by the usual method of forcing it through the water. The current created by the action of the forward cylinder passes entirely under the boat, and by lifting it up, aids in impelling it forward. Dr. Planton's models were submitted to a Select Committee, appointed by the last legislature of New York, who recommended them to the favourable consideration of the Canal Board. The Board have since expressed their approbation of the project.—*Newark Daily Advertiser.*

Mr. Hall's Steam-Engine Improvements.—Extract of a letter from George Peel, Esq., of the House of Messrs. Peel, Williams, and Peel, to Mr. Hall, of date 19th August last. "I yesterday witnessed, with much satisfaction, the performance of a pair of steam-engines, fitted-up with your recent improvements, on board the *Windermere.* The engines were working well, and making, without any thing like effort, thirty revolutions per minute; and, although the vacuum was impaired, in consequence of a defective joint, yet the barometer attached to the condenser indicated the rise of a column of mercury equal to 28¼ inches; the ordinary barometer standing, at the same time, at 30.2 inches"

Steam-boat Explosions.—Mr. Thomas Lunt, of Chester, suggests that the danger arising from explosions on board of steam-vessels might be very materially diminished by the formation of a permanent iron partition between the engine-house and the passengers' cabins. The hint seems worthy of consideration.—*Liverpool Mercury, August* 21, 1835.

The London and Greenwich Railway viaduct is now fast approaching towards completion, and presents a very imposing appearance. It forms a highly interesting object from the summit of Nunhead Hill, at the back of Peckham, from which the long range of arches, seen in nearly its entire length, appears like the "counterfeit presentment" of a Roman aqueduct. Nunhead Hill is decidedly the best point from whence to obtain a general view of this magnificent work, which there forms a part of the foreground to an exquisite and comprehensive panorama of the metropolis, in its whole enormous length, from Chelsea to Greenwich, with all its "domes and spires and pinnacles;" amongst which, those of Westminster Abbey and St. Paul's are, of course, the most conspicuous.

A Flight and no Flight.—The "Grand Aerial Ship, the Eagle," which was to have made the journey to Paris (in six hours) *early in August,* has, it seems, really disappeared from the place of exhibition. It was at one time reported, that certain evil-disposed persons had entered the inclosure in the night, and, cutting the cords which bound the "Eagle" to the earth, sent it on a voyage to the moon, *sans* pilot or compass! But it now appears this was all fudge, and that the Aerial monster, instead of taking a flying trip to Paris, and afterwards "to the other principal cities of the Continent," has got into the very unpoetical clutches of the Sheriff of Middlesex, under an execution for debt! The "European Aeronautical Society" (save the mark!) now say, that if John Bull will only arrange matters with his underlings, John Doe and Richard Roe, the flight may yet take place, and that to make up for past disappointments, the flight shall this time be to Pekin instead of Paris! Behold the farce of the Bottle Conjuror over again! To make amends for not going into the quart bottle, he promised that he would on his next night of performance squeeze himself into a pint one!

The Patent Laws Amendment Bill of Lord Brougham is now, as we infer from the newspaper reports of the proceedings of Parliament, become, after a great deal of silly coquetting about it between the two Houses, (as if it was of any moment how they passed such a thing through their hands) the law of the land. We shall furnish our readers with a copy of it in its enacted state as soon as we can possibly procure one; but, in the mean time, we would advise all patentees who contemplate taking any advantage under it, *to lose no time,* for most assuredly it will not survive another Session. A Bill of Amendment with less of real amendment in it was never certainly before concocted.

Communication between the Atlantic and Pacific across the Isthmus of Panama.—We published some months back the official proposals issued by the Government of New Grenada for the construction of a railroad across the Isthmus of Panama. We now learn from the *Athenæum* that "no contractor appeared at the stated time, either for a railroad or common carriage-road," but that "a French gentleman has entered into an engagement for cutting a canal for steam-boats or sailing-vessels, the draught of which is not to exceed ten feet," that is to say, on so small a scale, that it will "not admit the direct passage of even the smallest class of merchant vessels from sea to sea." The reason assigned for adopting so small a scale is, that "if vessels of war were able to pass the Isthmus, it would become a second Dardanelles, and an object of desire to the warlike nations of the world." We share in the fears expressed by our intelligent contemporary, that "a Government which can act under the influence of so mere a phantom as this, will not be equal to the successful accomplishment of this great design" on any scale; but we cannot subscribe to the conclusion which follows, that "a railroad conducted *chiefly through tunnels* is the true mode by which this pass must be made." We should as soon think of recommending a tunnel all the way through.

"Mohawk's" letter has been forwarded to Mr. H.

Communications received from Mr. Mackintosh—Lieutenant Wall—X. Y. Z.—K.—Mr. Dines—Mr. Davy.

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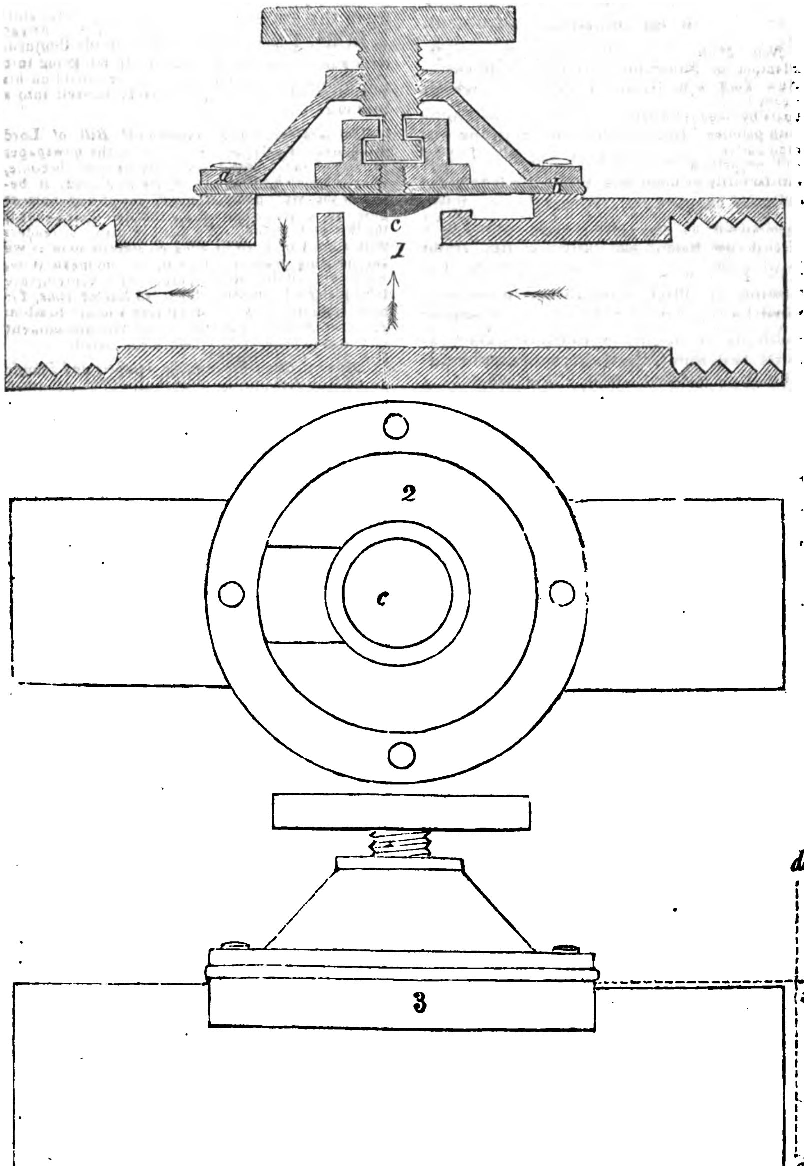
CARTER'S PATENT GAS-VALVE.



CARTER'S PATENT VALVE FOR REGULATING THE FLOW OF GAS AND OTHER FLUIDS.

The apparatus hitherto in use for regulating the flow of gas has been formed upon the principle of the ordinary liquor-cock, and that, even for its original purposes, is but an imperfect instrument. Mr. Carter, in constructing his new apparatus, has altogether discarded the cock-plug and substituted a valve, by which all the parts subject to friction are kept separate and totally excluded from the action of the gas. The plug and socket of the ordinary cock are acted upon chemically by carburetted hydrogen gas, be the instrument ever so well constructed and of the very best metal; and to shield them from corrosion, and prevent their becoming in consequence immoveable, they must be frequently lubricated with oil or some other unctuous matter. Now it must be evident, that where oil can be admitted as a lubrication, there must be a way for the escape of gas, in consequence of its very volatile properties; hence the frequent annoyance to consumers by escapes of gas, and the losses to proprietors by the waste from innumerable leaks, which, though trifling upon a single service or street burner, amount upon the aggregate to a very serious sum.

Mr. Carter, by a simple and novel arrangement, has succeeded in keeping all the parts of his apparatus which are subject to friction entirely separate from the gas; and in wholly confining the gas to the conducting-pipe when shut off. The valve by which the flow is regulated can neither stick fast nor leak; and any escape of gas is rendered impossible.

We anticipate from the introduction of this improved valve a great increase in the consumption of gas; for there need be no longer any danger of explosion from the accumulation of the inflammable fluid in cellars, or of annoyance from its escaping into the apartments of dwelling-houses where gas-lights may be used.

Description of the Engravings.

Fig. 1. A longitudinal section on the vertical line *de*, fig. 3.

Fig. 2. Section on the horizontal line *f*, fig. 3.

Fig. 3 Geometrical elevation of the apparatuscomplete.

The figures are of the full size, and represent the half-inch service-valve.

At *a*, fig. 1, is a cap, secured firmly by screws, which serves the purpose of fastening and protecting the pliable substance *b*. When the gas is to be admitted this pliable substance is raised by the screw through the centre of the cap; and when it is desired to shut it off, it is pressed upon the aperture *c*.

In fig. 1 this pliable substance may be described as a neutral point, neither raised nor depressed, although partially open; but when raised by means of the screw as much above the level as it requires to be depressed for the purpose of shutting off the gas, the column of fluid on passing through the aperture (*c*) expands into a column of more than eight times the capacity of the service; consequently, the small elevation of the valve requisite to prevent any undue strain upon the pliable substance *b*, is more than sufficient to carry as much fluid as the diameter of the pipe can convey.

The apparatus, when placed in the position of figs. 1 and 3, with a fall towards the main on the one side, and a fall towards the meter on the other, can never be choked by condensation; and if placed in the position of fig. 2, or vertically, it must be evident that no inconvenience can ever accrue from any accumulation of condensed matter.

The valve may be made of any dimensions, so as to suit equally the smallest burners and the largest service-pipes.

In applying this valve to water-works, Mr. Carter proposes to make the cap cylindrical which covers and secures the pliable substance, so that the disc may be extended to the full dimensions of the enlarged column; the extended disc will afford a protecting resistance against the pressure of the enlarged column of water upon the pliable intervening substance.

RIVER-SIDE RAILWAY—STREET PAVEMENT.

Sir,—Permit me to submit to the public, through your columns, a project, which would prove as advantageous as hereafter it may become necessary in this increasing metropolis.

Let three or four miles of a double railroad be established on the London and Westminster side of the Thames, upon a plan to cause no impediment to the water business of the river. On this railway a succession of steam-carriages

moving each way could be constantly plying. Convenient egress and regress to be provided at the ends of the short streets terminating on the banks of the Thames.

An undertaking of this sort would draw off many of the crowded vehicles from the leading thoroughfares, and leave them freer to be traversed by those who are compelled like me to use the footpath, and oft-times cross the streets in peril of their lives.

The details of this scheme I will not dilate upon; my time does not permit me so to do. If needful, hereafter I will say more.—Yours, &c.

T. C.

August 24, 1835.

P. S.—I am glad to perceive that some little alteration has been made in the size of the paving-stones for the horse-paths in our streets. Many years ago I suggested that smaller square-sided stones should be used, and showed, as I thought, plainly that the horses' feet must have a constant abutment at each step upon the interstices between the stones to secure their footing. The V form of the stones is altering, I see, by the breaking off the upper sides and edges of the old stones when used over again. This is all the better; but not near so good as using stones of smaller dimensions each way, *excepting in depth*. The new Cow-lane or King-street plan will prove a very bad one when partially worn down—as the indented one (by chiselling the large stones) has proved; *vide* Holborn-hill.

APHORISMS ON GENIUS.

(From the Welch Poetic Triads.)

1. The three foundations of Genius: the gift of God, man's exertion, and the events of life.

2. The three primary requisites of Genius: an eye that can see nature, a heart that can feel nature, and boldness that dares follow nature.

3. The three indispensables of Genius: understanding, feeling, and perseverance.

4. The three properties of Genius: fine thought, appropriate thought, and luxuriantly diversified thought.

5. The three things that ennoble Genius: vigour, fancy, and knowledge.

6. The three supports of Genius: strong mental endowments, memory, and learning.

7. The three ministers of Genius: memory, vigour, and learning.

8. The three marks of Genius: extraordinary understanding, extraordinary conduct, and extraordinary exertion.

9. The three friends of Genius: vigour, discretion, and pleasantry.

10. The three things that improve Genius: proper exertion, frequent exertion, and prosperity in exertion.

11. The three effects of Genius: generosity, gentleness, and complacency.

12. The three things that enrich Genius: contentment of mind, the cherishing of good thoughts, and exercising the memory.

13. The three things that exalt Genius: learning, exertion, and reverence.

14. The three supports of Genius: prosperity, social acquaintance, and praise.

15. The three things that will ensure prosperity: appropriate exertion, feasible exertion, and uncommon exertion.

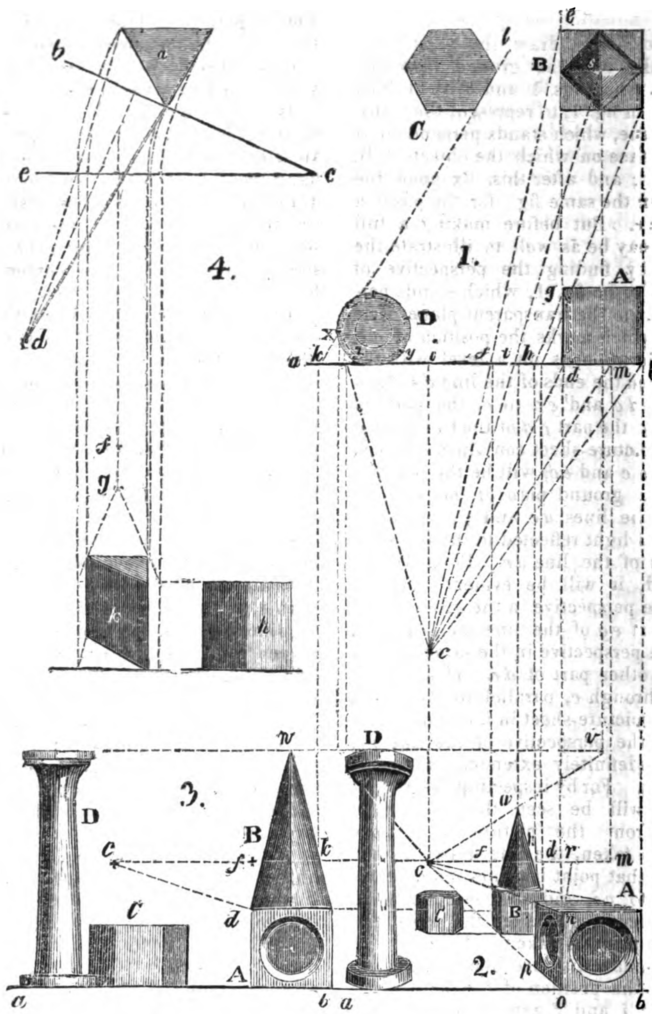
16. The three things that will ensure acquaintance: complacency, ingenuity, and originality.

17. The three things that will ensure praise: amiable conduct, progress in science, and pure morals.

BINDING LEATHER.

Sir,—Tanned seal-skins have equidistant black lines, barely a quarter of an inch broad, drawn upon them, leaving blank spaces between the lines of about the same width. These skins are afterwards cut into strips, one half of each being blank, for binding leathern shoes, so that the stockings of the wearer may not receive any of the black stain from the binding. Probably these black lines are ruled, one at a time, by guess, which I find to be a tedious and unsatisfactory process. I have, in consequence, tried a great many experiments to print the lines with a block, but without success. The leather, in this way, does not take a sufficient body of colour to form a clear stripe. I have also tried a pen, made of sheet-copper, to draw five lines at once, in the manner of a music-pen, but have not overcome all the difficulties attending its employment. Perhaps some of your numerous readers can and will assist me with information, in regard to the best process, and to the best composition of the ink or black dye for this purpose.—Yours, &c. A. M.

PERSPECTIVE MADE EASY.



Sir.—The following paper on *Perspective Drawing* is intended to be useful to those readers of your Magazine who want information on that subject, and who are not mathematicians enough to understand the ordinary treatises. By giving it a place in the Mechanics' Magazine, you will very much oblige,

Yours truly,
JAMES WHITELAW.

Glasgow, July 27, 1835.

1. If a person behind a transparent plane kept his eye exactly in the same position till he traced on the plane the objects on the other side of it, by means of a pencil carried over the parts of the plane, where the rays of light reflected to the eye from all the lines in the objects cut the plane, the delineation would be a perspective drawing of the objects.

2. Fig. 1 is a ground plan of a number of objects, marked ABCD, standing

on a horizontal surface: these same letters in fig. 3 point out the same objects in elevation; and fig. 2 is a perspective view of them.

3. In order to draw the perspective view, make first the ground plan and elevation, as in figs. 1 and 3, then draw a line *ab* in fig. 1, to represent the transparent plane, which stands perpendicular to the surface on which the objects A B, &c. stand; and after this, fix upon the point *c*, in the same fig., for the position of the eye. But before making a full view, it may be as well to illustrate the method, by finding the perspective of the line *d e*, in fig. 1, which stands perpendicular to the transparent plane. The point *f*, which marks the position of *d e*, in the elevation, is on a level with the eye. From the ends of the line *d e*, draw the lines *d c* and *e c* to *c*, the point of sight; and the part *f d* of the transparent plane or picture-sheet contained between the lines *d c* and *e c*, will be the perspective in the ground plan of the line *d e*, because the lines *d c* and *e c* represent the rays of light reflected to the eye from the ends of the line *d e*. From what is now said, it will be evident that *f h* shows the perspective in the ground plan of the part *e g* of the line *d e*, and that *h d* is the perspective in the same plan of *g d*, the other part of *d e*. If a line is drawn through *c*, parallel to *d e*, till it meets the picture-sheet in *i*, *r d* will show, in fig. 1, the perspective of the line *d e*, if it is indefinitely extended in the direction *d e*. For by inspecting the ground plan, it will be seen that the more distant from the picture sheet any point *e* is taken, the line drawn to the eye from that point becomes more nearly parallel to *c i*, and in consequence of this, *i f* becomes smaller the more distant the point is taken. Although we cannot name a distance from the picture-sheet for the position of the point *e* that will make *i* and *f* exactly coincide, yet we can place *e* so distant, that the space betwixt *i* and *f* will be smaller than any quantity that we can form a notion of, and for this reason *i d* must be considered the perspective in the ground plan of the line *d e*, when it is indefinitely extended from the point *d* in the picture-sheet, or from the point *f* in the elevation on a level with *c*, the point of sight in the same view.

4. We now know how to represent on an edge view of the transparent plane or picture-sheet, the perspective of any line or part of a line running perpendicular to the transparent plane on the same level with the eye; but in order to make a picture, the perspectives of the lines in the objects to be represented must be shown, not on an edge, but on an elevation of the picture-sheet. Let fig. 2 be this elevation, and in this fig. draw the line *a b*, which is just a continuation of *a b* in fig. 3, the line representing the surface on which the objects stand; then draw a line perpendicular to *a b*, in the perspective view, from the point *c*, in fig. 1, and a horizontal line *c m* from *c*, which marks the position of the eye in the elevation, and the point *c*, in fig. 2, where these lines meet, is the position of the eye in the perspective view. The points *c* and *i* in the ground plan coincide in the perspective view, as the line *d e* stands perpendicular to the picture-sheet in the side as well as in the up and down direction. And as this line *d e* has its commencement at the picture-sheet on a level with the eye, if lines are let fall from the points *d h* and *f*, in the ground plan, perpendicular to the line *a b*, in the perspective view, these perpendicular lines will cut the horizontal line *c m*, in fig. 2., in the points *d h* and *f*, and these points will be the perspectives of the points marked *d*, *g*, and *e*, respectively, in the ground plan. If the points *d* and *f*, in fig. 2, are joined, the line *d f* will be the perspective of the line *d e*; the part *d h* of this perspective line, is the perspective of *d g*, part of *d e*, and a line joining the points *d* and *c*, in fig. 2, is the perspective of the line *d e* in the ground plan, when it is indefinitely extended in the direction *d e*.

5. Let the line *d e*, fig. 1, have its commencement in the elevation at *d*, one of the corners of the cube A; its perspective view is found as follows:—From the point *d*, in fig. 1, draw a line *d o*, perpendicular to the line *a b*, in the perspective view; and from *d*, fig. 3, draw a line *d n*, parallel to *a b* in fig. 2, and the point *n*, where the line *d n* cuts the line *d o*, is the commencement of the perspective of the line *d e*; join *n c*, and this line will be the perspective of the line *d e*, when it is indefinitely extended. A line joining the points *o* and *c* is the

perspective of the line $d e$, if it is indefinitely extended when it has its position in the elevation at the corner of the cube under d. The point o, where the perspective line $o c$ commences, is found in the very same way as the point n was found. As $n c$ is the perspective of $d e$, when it is indefinitely extended from d, in fig. 3, one of the top corners of the cube A; and as $o c$ is the perspective of $d e$, when it is indefinitely extended from the corner under d of the cube A, in fig. 3, the triangle $n c o$ is the perspective of a parallel surface, standing perpendicular to the surface on which the objects A, B, &c. stand, and running at right angles to the picture-sheet to an indefinite distance from it. The side of the cube A, that is, towards the centre of the picture, and the same side of the cube under the pyramid, form part of the perspective of this parallel surface. The point p, where the line $h p$, let fall from the point h in the ground plan, perpendicular to the line $a b$ in the perspective view, cuts the line $o c$, is the perspective of the bottom corner at g, of the cube A; and the place where this same line $h p$ cuts the perspective line $n c$, is the perspective of the top corner g, of the cube marked A, in fig. 1. So now we have got the perspectives of the four corners of one of the sides of the cube in front of the picture, and by joining these corners we get the surface $n p$, and this surface is the perspective of the side of this cube, that is, towards the object D. A perpendicular, let fall upon the line $a b$, in fig. 2, from the point f, in the ground plan, will cut the lines $n c$ and $o c$, so as to give the perspectives of the top and bottom corners at e of the cube under the pyramid; and the other two corners of the side of this cube, that is, next the object C, is obtained in a similar manner. The manner of demonstrating what has been said in this paragraph about the perspectives of lines running perpendicular to the picture-sheet, from any point in it, to an indefinite distance from their commencement, is shown in paragraphs 3 and 4. Before proceeding farther, it may be as well to turn over and read remarks 2, 4, and 6.

6. We now know how to find the perspective of any point in a line that stands perpendicular to the transparent plane; but if the perspective of a point, which is not in a line so situated, be wanted, we can draw a line perpendicular to the picture-sheet through the point, (or suppose a line so drawn,) and find the perspective of the point, as if it had its place in this line. The following ***rule to find the perspective of any point in an object***, rests upon this principle. When the perspectives of all the points in an object are found, the perspective drawing of the object is completed by joining these perspective points.

Rule.

From the place of the point in the ground plan draw a line to the point of sight; and from the point where this line cuts the picture-sheet, let fall a perpendicular upon the line $a b$ in fig. 2. After this, from the place of the point in the ground plan, whose perspective is wanted, let fall another perpendicular upon the line $a b$, in fig. 2; on this perpendicular set up the height that the point stands at in the elevation above the line $a b$, measuring this height from the line $a b$ in the perspective view; then from the height so set up draw a line to the point c in the perspective view, and the place where this line cuts the perpendicular let fall from the point in the picture-sheet, where the line drawn to the eye in the ground plan cuts it, is the perspective of the point wanted.

Example 1.—Suppose that we want to find the perspective of the top point s of the pyramid B. From s, in the ground plan, draw a line $s c$ to the eye; and from the point t, where this line cuts the picture-sheet, let fall a line $t u$ perpendicular to $a b$, in fig. 2. Then from the point s let fall a line $s v$ perpendicular to $a b$, in fig. 2; on this line set up the point v, above the line $a b$, at a distance equal to the height of the top w of the pyramid, above the line $a b$, in the elevation, and from the point v draw a line to c, in the perspective view, and the point u, where the lines $v c$ and $t u$ intersect, is the perspective of the top point of the pyramid. As all the lines that run up the sides of the pyramid meet at the top, the perspective view of the pyramid is completed, by finding the perspective of the other ends of these lines, and joining as many of these points as are not hid by surfaces in front of them with the point u, and then join the perspectives of the

points at the bottoms of the lines, the one with the other. The method of drawing the cube in front of the picture, and also the cube on which the pyramid stands, is fully sketched out in the engraving. The six-sided prism C is drawn in perspective, in the very same way as the pyramid—by finding the perspectives of the points at the ends of all the lines in it, and joining these perspective points.

Example 2.—To find the perspective of a circle, or any other curve. In order to illustrate this example, we shall take the circle on the top of the pillar D. Mark off at random any number of points, $x y z$, in the ground plan of this circle, and find by the rule the perspective of each of these points; then when that is done, connect the perspective points by a curve line, and this line will be the perspective of the circle on the top of the pyramid. The method of finding the perspective of the point x is sketched out in the engraving.

Remarks.

1. Figs. 1, 2, and 3, are drawn on a drawing-board, in such positions that the lines marked $a b$, the one in the elevation and the other in the perspective view, are parallel to the line ab, which represents the picture-sheet in the ground plan; and these lines are drawn with the square applied to the edge of the drawing-board in the ordinary way; so in every instance where it is wanted to draw a line perpendicular to the line $a b$, in the perspective view, the thing is done at once by means of the drawing-square. And when the height at which any point stands above the line ab, in the elevation, is wanted to be set up on the line drawn perpendicular to $a b$, in fig. 2, from the position of the point in the ground plan, you have only to apply the drawing-square to the place of the point in the elevation, and draw a line across the drawing-board, and this line will cut the perpendicular line at the proper height above ab in fig. 2. Now, it will be evident how the ground plan and elevation should be placed, in order to draw the perspective view easily.

2. Points, lines, and surfaces, in contact with the transparent plane, must be in the same position with respect to each other, and must have the same shape and dimensions in the perspective view that they have in the ground plan and the elevation, as the lines drawn to the eye representing the rays of light, do not converge till after they cut the transparent plane. This is the reason why the position of the point of contact of a line commencing at the picture-sheet is found in the perspective view, in the point where a horizontal line drawn from the place of the point in the elevation meets a line let fall from the place of the point in the ground plan, perpendicular to the line $a b$ in the perspective view.

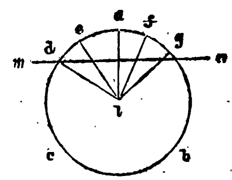
3. The line ab, in fig. 2, shows the intersection of the transparent plane with the horizontal surface on which the objects stand. If the objects do not stand on a horizontal surface, the line ab, in fig. 3, represents a horizontal surface drawn through the lowest point in the objects; and $a b$, in fig. 2, shows the intersection of this horizontal surface with the picture-sheet. The lines marked ab, in the perspective view and in the elevation, need not be drawn when the position of the elevation is such, that the height of any point in an object can be set up on the line drawn perpendicular to ab, in the perspective view, from the place of the point in the ground plan, by means of the drawing-square. But they (the lines marked $a b$, in figs. 2 and 3,) are of great use when the elevation cannot be got in a proper position, or when the elevation is drawn on a separate sheet from the perspective view.

4. As c, in the elevation, marks the position of the point i, as well as the point of sight, draw a line parallel to $a b$, through c, in fig. 3, till it cuts a line, let fall from the point i, in the ground plan, perpendicular to $a b$, in fig. 2, the point c, in the perspective view where these lines meet, is the position of the point i. The point c, in fig. 2, is also the position of the point of sight, for a point must be placed above, or below, or to one side of the point of sight, before the lines drawn to the eye which represent the rays of light from the point, and which mark its position on the picture-sheet, can converge or diverge betwixt the point and the transparent plane.

5. The *vanishing point* of any line beginning at the picture-sheet is the point in fig. 2, which terminates the perspective of the line when it is extended to an indefinite distance from the point

where it commences in the picture-sheet; thus, the point *c*, in fig. 2, is, as was shown before, the vanishing point of the line *de*, in the ground plan; and this same point *c* is the vanishing point of every line running parallel to *de*. The vanishing point of any line *k l*, fig. 1, running level with the eye, but inclined to the picture-sheet sideways, is found by drawing the line *c m*, in the ground plan, parallel to *kl*, till it meets the picture-sheet in *m*; and this point *m* is the vanishing point in the ground plan of the line *k l*, and of every line in the objects to be represented running parallel to it. From the points *k* and *m*, in the ground plan, draw lines *k k* and *m m*, perpendicular to *ab*, in the perspective view, cutting the horizontal line passing through the point *c*, in fig. 2, in the points *k* and *m*, the point *m* is the vanishing point of the line *k l*; and if the points *k* and *m* are joined, the line *km* will be the perspective of the line *kl* when it is indefinitely extended. The point *m* in the perspective view is also the vanishing point of every line in the objects to be represented, that runs parallel to the line *k l*. The vanishing point of any line commencing at the picture-sheet, or at this sheet produced, and inclined to it in the up or down directions, as well as sideways, is found in the point, where a line drawn through the eye parallel to the line whose vanishing point is wanted, meets the picture-sheet. The reasons given in paragraphs 3, 4, and 5, to prove that *i*, in the ground plan, and *c*, in the perspective view, mark the vanishing point of lines running at right angles to the transparent plane, apply to lines running in the directions mentioned in this remark. You will now be able to find the perspective of any line running in any of the directions now mentioned, without the aid of the rule given in this paper, and you will also be able to make a variety of rules for finding the perspective of a point different from the rule that I have given.

6. From what has been said in paragraphs 4 and 5, it may not be plain to every one, how that the points marked *g* in the ground plan, and shown by the points *f d*, and the corner of the cube under *d* in the elevation, should have their positions in the same line, *hhp*, perpendicular to the line *a b* in the perspective view; or, in other words, it may not be evident, how in the case of every line in the objects to be represented, which has a perpendicular position, its perspective should stand perpendicular to the line *ab* in fig. 2. In order to understand this fully, let *abc*, in the following figure, represent the end of a hollow cylinder, standing in a perpendicular direction, with a number of plane surfaces *di*, *ei*, *fi*, *gi*, and *ai*, radiating from its centre *i*.



Now, if this cylinder be cut parallel to its axis by any plane *mn*, the radiating planes will always be cut, so that their intersections with the cutting plane will be perpendicular; this is so obvious, as to need no demonstration. But the lines whose positions in the end-view of the cylinder are *d e a f g*, and which mark the places where the radiating planes meet the circumference of the cylinder, are perpendicular lines; each of which may be considered a line in some object to be represented, and *mn* will represent the transparent plane. Let the eye have a position any where in the axis of the cylinder—the rays of light reflected from the whole line *f*, or from any part of it, to the eye, will form a triangle in the plane *fi*, and the intersection of *mn* with this triangle will be the perspective of the line, or part of the line, whose position is *f*; but the intersection of the plane *mn* with the plane *fi*, is a perpendicular line; so the part of this intersection which forms the perspective of the line, or part of the line, whose position is *f*, must be perpendicular. The same reasoning applies if the lines in the objects to be represented stand at any of the other points, *d e a*, or *g*, or even if the line does not stand in a point in the circle representing the circumference of the cylinder; for in this case a new circle may be drawn, and every thing else can be shown as above. I may just mention it, for the thing can be demonstrated on the principles now developed, that level lines in

the objects, running parallel to the picture-sheet, are also level in the perspective view; and lines in the objects to be shown, that are inclined to the horizon at any angle, and which keep parallel to the transparent plane, run at the same angle to the line ab in the perspective view of these lines. The top and bottom lines of the front side of each cube, and the top and bottom lines of the front side of the six-sided prism C, also the outside and inside lines that form the top angle of the pyramid, and some other lines in the figures, illustrate this remark. The lines now noticed, though indefinitely produced, have no vanishing point.

7. The eye should not be nearer to the picture-sheet than the greatest height or breadth of the picture; and it should be placed in the ground plan, so that a line let fall from it perpendicular to the picture-sheet should bisect the angle xcb, formed by lines drawn to it from the points which mark out the greatest width of the picture. The line ci in the ground plan does not bisect the angle xcb; but this was done to save room, and to show some parts of the objects that could not have been so well represented, if the position of the eye had been more nearly opposite to the centre of the picture. If the eye is very distant from the picture-sheet, a perpendicular let fall from it to the picture-sheet need not fall exactly on the centre of the picture.

8. When the line drawn perpendicular to the line ab, in fig. 2, from the point in the ground plan whose perspective is wanted, nearly coincides with the line drawn perpendicular to the same line ab, from the point in the picture-sheet where the line drawn to the eye from the point in the ground plan cuts it, the height of the perspective of the point cannot be so exactly found by the Rule, as the line drawn to the eye in the perspective view is in this case nearly a perpendicular line; and the place where this line cuts the line let fall perpendicular to ab, in fig. 2, from the point in the picture-sheet, where the line drawn to the eye from the place of the point in the ground plan cuts it, is not so exactly marked as when these lines which mark by their cutting the perspective of the point, cross each other in a direction nearer the perpendicular. When great exactness is wanted in a case of this kind, it will be the better way to find the perspective of a horizontal line, parallel to the picture-sheet, passing through the point whose perspective is wanted; and the place where this perspective line cuts the line drawn perpendicular to the line ab, in fig. 2, from the point in the picture-sheet where the line drawn from the place of the point in the ground plan cuts it, is the perspective of the point.

9. When a number of circles are concentric, or nearly so in the ground plan, it will save drawing a great many lines, if, after the perspective of one of them is drawn, a number of the points taken in the ground plan of the other circles to draw their perspectives by, are in the lines drawn to the eye, which pass through any of the other circles, or in these lines produced from the points in the ground plan that were used in drawing the perspective of the first circle: as in this way, the lines already drawn perpendicular to the lines ab, in fig. 2, from the points in the picture-sheet where the lines drawn to the eye cut it, will answer for all the circles. By taking the points in the ground plan of the other circles, to draw their perspectives by, where the lines let fall perpendicular to ab, in fig. 2, from the points in fig. 1, that were used in drawing the perspective of the first circle, cut them, a deal of drawing is saved; as one set of perpendicular lines to put the heights on, will pass through a great many points in all the circles. Produce the lines perpendicular to ab, if they are let fall from points on the side of the first circle, that is, towards ab. The perspective of any circle which stands in a plane parallel to the picture-sheet, is a circle. If a circle is placed in a plane which would run through the point of sight if produced, its perspective view is a straight line. The perspectives of circles having any other positions than the two now mentioned, are ellipses.

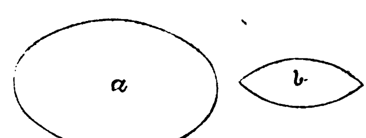


Fig. a, shows an ellipse; and fig. b, which is formed of two segments of a

circle, is the way in which persons who do not understand the subject draw a circle in perspective.

10. If in the ground plan, or the elevation, one part keeps another out of sight, the part hid must be drawn, before its perspective can be made. The dotted lines in the ground plan, showing the small moulding on the top of the pillar, and the dotted lines in the same plan, that show the round panels in the cube that is close to the picture-sheet, illustrate this remark.

11. If a picture is wanted, in which the transparent plane does not stand perpendicular, the easiest way to make it, is to consider the picture-sheet perpendicular, and draw the figures, corresponding to the ground plan and elevation, as if the objects were put off the perpendicular, by elevating one side of the horizontal surface passing through the lowest point in them.

12. Sometimes after the ground plan of any object, or number of objects, is drawn, it may be considered better not to have the picture-sheet in this plan parallel to the top or bottom edges of this drawing-board, but in a direction such as the line *b c*, in fig. 4, is drawn. When this happens, draw, as in fig. 1, lines from all the points in the ground plan to *d*, the point of sight; then let fall perpendicular lines from the same points to the picture-sheet, *b c*; after this, draw from a point *c*, (which is beyond the lines drawn from the place of the points in the ground plan to the picture-sheet,) the line *c e*, parallel to the top or bottom edge of the drawing-board. Then from the point *c*, where the lines *b c* and *e c* meet, with a pair of pencil bows draw circles to *e c*, from all points in *b c*, where the perpendicular lines, and the lines drawn to the eye from the points in the ground plan, meet it; also the point where a perpendicular let fall from the point *d*, to the picture-sheet meets it, must be transferred by means of the pencil bows to the line *e c*; and perpendicular to *e c*, from this last point transferred mark off the point *f*, at the same distance from *ec*, that *d* is from *b c*. It will now be evident, that transferring the points *b c* to *e c*, and setting the point *f*, in the position mentioned above, produces the same effect, as if *b c*, with all the points on it, together with *d*, the point of sight, moved with the same angular motion round the point *c*, as a centre, till *bc* came to the position *ec*. The point *d* would then coincide with *f*, and *e c* would be the picture-sheet with all its points upon it, brought into a position parallel to the bottom of the drawing-board. When the operation is thus far gone through, the rest of the process is conducted, as if the ground plan had been drawn to suit the picture-sheet in the position *e c*. In order that fig. 4 may be fully understood, I need only add, that *h*, is an elevation of the object *a* in the ground plan, and *k* is the perspective view of it: *g* in the perspective view being the position of the eye, or the vanishing point of the lines running perpendicular to the picture-sheet. Rather than draw a perspective view with the position of the picture-sheet in the ground plan inclined to the sides of the drawing-board, as in fig. 4, it will be better to shift the blade of the drawing square, so as to draw the ground plan of the objects at the required angle to the picture-sheet, when it is in a position as in fig. 1.

13. When a figure in the objects to be represented is parallel to the transparent plane, the perspective of the figures is similar to the original one, but less in magnitude according to its distance. J. W.

EVIDENCE OF DR. LARDNER

On the Great Western Railway Bill,

3d of August, 1835.

The Earl of Radnor in the Chair.

Dionysius Lardner, LL.D., being examined, gave evidence as follows:—

You have heard a good deal said in extenuation of the Box tunnel; what is your opinion upon that subject?—The combination of a tunnel with a slope appears to be the objection to it; and the power requisite to pull a load up a slope of 1 in 107 is greater than the power necessary to pull the same load on a level in the proportion of 30 to 9.

In round numbers, nearly 3½ to 1?—Yes; it requires 9 lbs. per ton to pull a load on a level line, and it requires 30 lbs. to pull it up 1 in 107.

Applying your attention to the question of the tunnel, in what way is that difficulty aggravated beyond the mere proportion of the greater power required?—The increased power necessary for a slope must be produced

by a proportionably increased consumption of fuel; that will produce a proportionably increased destruction of atmospheric air; and, of course, if the tunnel be intended to be kept as pure on the slope as it would be necessary to keep it on a level, the transverse section of the tunnel ought to be greater on a slope than on a level in the proportion of 30 to 9.

Mr. Joy.—Your attention has been called to railways in various parts of the world; do you know of any parallel to this, uniting the length of this tunnel with that inclination?—No, I am not aware of any.

Is it justifiable, except in a very extreme case, to unite those two disadvantages, such a length of tunnel with that inclination?—I think nothing but an overruling necessity could justify it.

Have you considered the different modes proposed for working that tunnel; additional locomotive power or a stationary power, either by an endless rope or a single rope?—Yes.

Have you also considered it as worked partly by the one and partly by the other?—Yes; it might be worked partly by one and partly by the other; the tunnel is not the same length as the slope; the slope is two miles and a half, and the tunnel a mile and three quarters in length; it might be worked by a rope through the tunnel.

First, as worked by locomotive-engines, what would there be its great objection?—I think I have stated its great objection already; the probable difficulty attending the destruction of air by the fire; and in considering that it appears to me that it ought to be considered, not so much with regard to the positive injury that may be produced to the health or life of the passengers—I do not think there would be any—but with regard to the unpleasantness and inconvenience arising from the existence of a quantity of noxious vapour through which they would be carried.

That is an objection more or less applicable to tunnels upon a level?—Less applicable to them, because there would be less power requisite.

Would the atmosphere of the tunnel be injuriously affected and impregnated with the gases produced by the combustion?—Not injuriously, but inconveniently, I think.

You have stated that there would be so much greater power required, and that requiring a greater proportionate quantity of combustion, that the ill effects would be produced in that proportion. What would be the proportion of increase in the consumption of fuel?—As 30 to 9.

In the same proportion as the increase of power?—Yes.

Mr. Joy.—Would there be as much air consumed in that tunnel as in a tunnel on a level of five miles and $\frac{4}{5}$ths long?—Yes, nearly. The length of the tunnel would be in the proportion of 30 to 9; there would be as much air consumed in this tunnel as there would be in a level tunnel longer in the proportion of 30 to 9.

Do you think any method of ventilation could be attainable that would render it otherwise than almost intolerable?—I scarcely think that the common mode by shafts would do it.

I have asked you whether it was actually practicable; is it not a feature devoutly to be avoided?—Yes.

To be avoided at almost all hazards?—Yes.

Would it be an eligible thing, such a tunnel in the course of a line, or almost intolerable?—I think it could be justified only by overruling necessity.

Mr. Joy.—Is the grievance much the same, or very materially aggravated, by such a tunnel and such an inclination being in the middle of the line, rather than at the extremity?—Yes, it is more objectionable than at the extremity.

Why?—Because of the unpleasantness, and the interruption to the transit of the trains when the passengers are in them; you come to a stand-still; they must undergo a change in the moving-power, and a similar change takes place at the top. At the end, if there is a tunnel, passengers hardly consider they have started until they have already passed through the tunnel; that is the case upon the Liverpool line, where there is a short tunnel at starting; no one could have travelled that line without feeling that had that tunnel occurred at Rain-hill instead of where it is, it would have been felt a much greater inconvenience, though the absolute loss of time might not be more.

Supposing Mr. Brunel shall have said, in answer to a question as to the danger of the atmosphere being rendered noxious by the passage of the engines, "I think not; there is one in existence upwards of a mile, and another on the Birmingham line;" and again, when asked, "Is the inclination so steep;" if he should have said, "It will not affect the atmosphere," is that correct or erroneous?—I think Mr. Brunel is in error there; it would affect the atmosphere.

In point of fact, is it not true that there will be an additional difficulty, as to the ventilation, from the increased power that will be requisite?—It will require more ventilation in the proportion of 30 to 9.

If it is assumed by the engineers on the other side, there will not be more ventilation required than on a level, that is an over-

sight in your judgment?—Yes, that is an oversight, I suppose.

Supposing coke used instead of coal, would not the gas produced be more noxious?—No, not more noxious; it is the same gas; the combustion of coke produces carbonic acid gas, sulphurous acid, and azote. Coal would be quite inadmissible.

Mr. Joy.—Would not the gas that would escape from coke be of a more injurious nature if it existed in any quantity?—Yes; it is not only gas that escapes from the combustion of the coke, but the gas that is decomposed in the atmosphere would be more injurious.

Would not this gas, unless it found a vent in a heated state, be likely to remain?—Yes, from its specific gravity: it is half as heavy again as the atmospheric air; the carbonic acid gas.

That is the offensive gas of which you speak?—Yes, the gases are mixed together, and if they cool they are heavier than the atmosphere, and apt to remain.

The mischief must very much depend upon the quantity? Is not the carbonic acid gas what the miners call choke damp, in a great degree?—Yes; it is what exists in wells and in the Grotto Del Cane.

If it is an excessive quantity, it is fatal to life?—Yes.

The degree of injury, if any there be, must depend upon the proportion?—Yes.

It may be diluted with common air, so as not to be fatal to life or health?—Yes, there is always a quantity in the air.

If the extra power is supplied by a stationary engine, the consumption of fuel would not be greater in the tunnel?—No.

Mr. Joy.—Have you made calculations of the proportions of these gases?—Yes; of the proportions of foul air to be produced.

Without troubling you to go into it in any detail, could you tell us the different gases you think injurious: the round sum of them produced in the passage through this immediate tunnel, for a load of 100 tons in a tunnel of a mile and three quarters long, upon a slope of 1 in 107? Have you calculated the quantity of noxious gas that would probably be made?—Yes; the total quantity, taking for granted that it takes half a pound of coke per ton per mile upon a level to draw a train, which, I believe, is in practice nearly the case, the quantity of noxious gas produced in this tunnel would be something less than 4,000 lbs. weight, with a load of 100 tons.

Every time a train goes through?—Yes.

Mr. Joy.—Does any objection exist with regard to the assistant engineer on the Manchester and Liverpool line; they have one there?—Yes; not in a tunnel.

I am speaking of the inclination; is there not an inclination on that line very near this?—Yes; 1 in 96.

Is there any practical inconvenience there, as you have observed the line so frequently, with reference to the additional engine?—The additional engine is not always ready to assist the train, and they have sometimes to wait.

Have they sometimes to wait from its being out of repair?—They have delays from various causes; it may not be lighted, or it may be employed upon one train, when wanted for another.

Have you known trains come to a dead stop on that inclined plane?—Yes; I have been upon it more than once when that has happened.

Have you had to wait a considerable time?—Yes, until the engine could be got.

Would the extra cost necessary for keeping this engine ready for use be another objection?—Yes; they would be always obliged to keep it ready for use, whether wanted or not.

I will call your attention to another mode mentioned, that of the endless rope; have you made a calculation of what would be the result if that system was practised?—Yes, I have.

What on the Liverpool and Manchester line, where they have a slope of 1 in 48, is the one they use?—That slope is 2,000 yards long, and the rope they use is a six inch rope, to draw loads of twenty-five tons.

At the rate of about ten miles an hour?—I do not think the rate makes any difference in the strength of the rope.

Is that the rate?—Yes.

What sort of rope would the Box tunnel require, taking the Liverpool one as the basis of your calculation?—I consider it will require a seven inch rope.

What would be the weight of a seven inch rope per yard?—I believe the weight of a seven inch rope would be six pounds and a half per yard.

What would be the total weight produced?—The total weight of that endless rope would be about 57,000 pounds.

How long?—About five miles.

Mr. Joy.—Calculating the friction of such a rope thus worked at about a twelfth of its weight, which was the proportion given by Mr. Stephenson and Mr. Locke, what pull would it require to work a train of fifty-two tons?—To propel fifty-two tons upon a slope of 1 in 107 will require for its gravity a 107th part; you are to divide the 52 by 107, and you will get the power of draught necessary to overcome the gravity of the load.

What would that be?—1,088 lbs.; then

there would be the friction of the load, which is at the rate of 9 lbs. per ton, which for fifty-two tons, 468 lbs; these two together would come to 1,556 lbs.; that is exclusive of the rope. Then the experiments of Mr. Stephenson and Mr. Locke on the friction of the rope show us, that the friction may be taken at about a twelfth part of the weight of the rope; and those experiments appear to me to be very satisfactory and conclusive; there was an average of several taken, and they have given very nearly the same result; and taking one-twelfth part of 57,000 lbs. you will get the force necessary to pull the rope, which alone is 4,752 lbs.; the load therefore would require 1,556 lbs., and the rope 4,752 lbs., making a total of 6,308 lbs.

Is not the result of this calculation, that it would require about three times the power for the rope, compared with the load?—Yes; for a load of fifty-two tons it is in the proportion of 15 to 47, very nearly.

To move that at the rate of fifteen miles an hour would require what power as expressed in horses? — Twenty-five pounds pulled at the rate of fifteen miles an hour is equal to one-horse power, and therefore 6,300 lbs. pulled at that rate, would be equal to 252-horse power.

Have you a corroboration of that result from the proposed engine on the tunnel now making on the Liverpool and Manchester railway? —The tunnel for passengers is a tunnel of a mile long, I think.

What is the power of the engine there proposed?—It is, they say, 140-horse power.

That is for passengers only?—Yes, for light loads.

What is the declivity there?—1 in 100.

Very nearly the same as here?—Yes.

Mr. Joy.—Is that consistent with the calculation you have just been giving to the Committee?—Yes, it agrees very nearly with it, as nearly as possible. I should state it would be necessary to have two engines, one to work while the other is accidentally deranged or repairing, otherwise the whole traffic upon the road will be stopped; there must be a pair of engines.

May not that be estimated at a lower tonnage in consequence of it being intended for passengers only?—Fifty tons is the amount of an ordinary load of passengers, including carriages.

Is not that about half the length of the Box tunnel?—Yes, it is about a mile long.

Is it correct to suppose that a five and a half inch rope would be sufficient for the Box tunnel, because the incline is flatter than the tunnel upon the Manchester and Liverpool railway of 1 in 48?—No, because the length is there omitted; the length is a very material consideration; it is a much more material consideration than the degree of acclivity.

Would the calculation of the sufficiency of rope, a five and a half inch rope, be conclusive if it was applied to so much shorter a line?—No; the acclivity has nothing whatever to do with the calculation; an endless rope, which would be sufficient for a certain load on one inclination, would be sufficient for any other inclination: the weight of the rope has nothing to do with it; it balances itself.

In order to arrive at a proper conclusion, is it not necessary to take into account the greater length of the line?—Yes, and that alone.

And not the steepness?—Not when it is an endless rope; a single rope would require steepness to be taken into consideration, but not an endless rope.

At the tunnel in question, on the Liverpool and Manchester line, is not the load of the locomotive divided into five or six different portions, and drawn up at five or six different times?—Yes; it is drawn up in loads of twenty-five tons: this would not do in the middle of a line.

Is it comparatively unimportant at the end?—If the load was to be drawn up in that way in portions in the middle of the line, the line would be occupied a considerable time, and the trains of passengers would be stopped until all this business of carrying up the loads was finished; and even at the end of the line, unless the slope was exclusively devoted to goods, it would not do there.

If a load of 100 tons were to arrive at the top of such an inclination, there would be a waste of time in the arrangements necessary to divide it?—It would be divided into four, and then one would be drawn up, and then another.

Whereas 100 tons can be very easily moved upon other parts of the line?—Yes.

Do you happen to know whether the elder Mr. Stephenson asserts that an endless rope of five miles long is impracticable?—Yes, I recollect he says that.

Do you agree with him?—Yes, it is within the bounds of mechanical possibility I think, but in the common sense of the word it is impracticable; I hardly think any one would attempt it.

Have you any idea that it would be adopted?—No; the power expended upon the rope would be so preposterously great compared to the load to be drawn.

You consider it, in common parlance, impracticable?—Yes.

Now turn to the single rope. Suppose it is to be worked by a single rope, is it one of the objections necessarily involved in a

single rope, that there must be a small locomotive to draw it back?—There must be some means to draw it back again, and the weight is so considerable that the power must be considerable.

Do you consider, speaking of a single rope, it would be but half the length?—Yes.

Two miles and a half; would not that require a small locomotive in consequence of its length?—It would require a considerable power, and a small locomotive would do it.

Would not there be some objection to that in consequence of its consumption of vital air in the tunnel?—Yes; that would be an additional inconvenience.

Would it not be a constant expense?—Yes; there would be constant expense in the consumption of fuel.

Is the original cost of such a rope heavy?—Yes.

Is the wear and the tear considerable?—Yes.

Has it to be often spliced?—Yes; the rope on the Liverpool tunnel is spliced twice a week, I believe.

Are the sheaves and the pulleys that the rope runs upon likely to break and get out of order?—Yes.

What is the number of those pulleys in a mile?—220 in a mile, I think.

Do you know any thing of the cost of those pulleys?—From 15*s*. to 20*s*. is the cost, where less power is used.

Would not this mode require about three times the power usually expended?—Yes; I should say in the proportion of 15 to 47 by an endless rope.

I am speaking of a single rope?—There would be less waste of power in a single rope, but we must take into account the power to carry it back.

Would it not come nearly to what I have stated?—I have not calculated that.

Have you any objection to stationary-power in the midst of a line like the Great Western?—Yes; there is an objection to it, in the interruption it would occasion in the rapid transit of passengers and the change of power; those are sufficient objections to it.

What would be the sort of power necessary to draw up a single rope?—It would be pulled back by an engine attached to the end of a single rope, which would draw it back.

If the load be 110 tons, should you not require a rope nine inches in circumference to draw it up?—That is for an endless rope.

Mr. Talbot states, that an endless rope had never been proposed, from the beginning to the end, by the parties promoting the Bill, and that calculations based on the assumption that it was to be used were therefore irrelevant.

Mr. Joy is heard in answer to the observation.

Mr. Joy.—Leaving both the endless rope and the single rope, I wish to call your attention to the breaks. There was an experiment stated by Mr. Brunel on the Canterbury and Whitstable inclined plane. Is that applicable to the Box tunnel? Supposing it to be stated by Mr. Brunel, with reference to the Canterbury and Whitstable Railway, "I have been down that plane twice, without a rope in the carriage, alone, with nothing but a break to check the carriage, and allowing it to run all its full velocity; by the break it was stopped in 60 yards.—How many passengers were there in the carriage? We were five only; of course, I did not try an experiment of that sort with many passengers.—Was it fully loaded? No." I would ask you whether that gives at all a sufficient explanation of the practicability of stopping such trains as would usually go on such a line as this; upon such an inclination as the Box plane?—No; because the power of the break is inversely as the load; and though you might stop a waggon loaded with five persons (I believe the average weight of a man is 150lbs., which would be 750lbs. plus the weight of the waggon), though it might be easy to stop that with a break, it would require a greater power by the break to stop it with a greater load—a power greater in proportion to the load. You cannot infer much from that experiment.

Supposing the carriages to start from the top of the plane in a state of absolute rest, what resistance would be required in order to limit its speed to 30 miles an hour?—It will be the resistance of the same number of pounds per ton, whatever be the limit of the velocity. The circumstances will be these: a train descending a slope of 1 in 107 has a downward tendency, which would be balanced by 12lbs. per ton; and, of course, whatever the velocity you want to restrict the train to, the break should exert a retarding force amounting to 12lbs. per ton.

Taking those data, what resistance would it be necessary to exert through a distance of two miles and a half, 7,588 feet?—To limit the velocity to 30 miles an hour, supposing it to begin from a state of rest, the trains starting from a state of rest at the top, and being allowed to proceed by gravity only, without power, would acquire a velocity of 30 miles an hour after passing over 5,612 feet. Then supposing the break to be applied, so as to check any further increase of velocity, it must exert a force of 12 lbs. per ton in order to do that, and that force must be exerted through the remainder of the slope, which would be 7,588 feet; and the total force would be equivalent to 4,500,000lbs., raised a foot high.

You have stated that, on the supposition that the train starts from a state of rest; is it not notorious that they constantly do start with a considerable degree of velocity?—They never do start from a state of rest.

At what sort of speed do the trains generally arrive at the summit of such a plane?—At the top of the slope on the Manchester Railway they generally arrive at the rate of 20 miles an hour.

I need hardly ask you whether the increased velocity you have spoken of would not then be much more dangerous?—The velocity would be much more increased if it broke loose from the break.

If Mr. George Stephenson should have stated that the break often fails to act; is he correct in that?—Yes; I have seen it frequently fail on the slopes on the Manchester Railway.

Did you ever find that inconvenience yourself when making experiments on that railway?—Yes.

On an inclined plane of 1 in 96?—Yes; I have seen it totally fail with a train of goods; it was burnt; the friction burnt it.

Just state the particulars of that?—I was descending the slope of 1 in 96 on the Manchester Railway, with a train of goods; the engineer let the train run down for a considerable time without the break, and we obtained a velocity that appeared to me to be exceedingly dangerous. I ordered him to apply the break, but the break totally failed; it was burnt. A signal was made to us by the road police to stop, but the train did not stop for a considerable distance from the foot of the slope. When we descended we found that the wheel of one of the waggons had broken, so that both wheels dragged along the rail during the descent, forming a more powerful break than the common breaks, and, notwithstanding this, the train went down with this furious velocity.

Do you know what the velocity was?—I can only conjecture that it was something very great; I should say from forty to fifty miles an hour.

Have you ever had any other misfortune of the same kind in a curve?—Yes, I did; I recollect an instance of it in a curve or bend in the line; that was not on a slope; it was nearly level.

State the circumstances?—I was proceeding from Liverpool to Manchester with a train of passengers, and at a bend in the line, where, from the flexure of the road, the engineer could not see a great distance before him, it happened that a train of stone waggons was occupying the road in advance; a signal was made to the engineer by the road police to cut off the steam and put the breaks on to retard it; and he alleged that he did so; but the velocity continued to be so great, notwithstanding the breaks, that we came against the train of stone waggons, and smashed them all to pieces; the waggons were broken all to pieces, and the stones thrown about, and the framing of the engine, though of strong iron, was broken.

Did you knock the stone carriages to pieces?—Yes. We were protected by the engine and the springs; some of the passengers were bruised a good deal. There are provisions made in the carriages that carry passengers to protect them from the effects of collision, but there are none in the case of stone waggons.

Was this upon an embankment or a cutting?—It took place in a cutting quite sufficient to hide the waggons.

What is the length of the radius of the curve where this accident took place?—It is a very considerable radius.

Mr. Joy.—Do you know the radius at the bottom of Box Hill?—It is stated to be three quarters of a mile.

If you were in a cutting would not that aggravate the difficulty, as you would not see the waggons before you?—Yes, it would.

What is the distance of the curve from the end of the Box Plane?—I believe it is stated to be a quarter of a mile.

In your judgment, is it sufficient to prevent any injury at that distance?—There will be great danger of having undue velocity; and on arriving at that curve, if the break should fail, the engine would arrive at the curve with very considerable speed. A quarter of a mile would make very little abatement.

If it should be contended that a quarter of a mile is sufficient to obviate any aggravated inconvenience from the velocity, is that correct?—If accidental velocity be acquired it is not, but if all precautions are taken there is no danger in arriving at the curve; but upon the trains breaking loose, and acquiring that velocity that the descent would give them there would be danger.

Is it not objectionable that there should be such a curve at the bottom of an inclined plane?—Yes; it would be better further off.

Though a quarter of a mile is sufficient for the expenditure of the common power, is it not insufficient for the expenditure of the dangerous power acquired by that increased velocity?—Yes, it would be.

In your judgment, supposing the train to be worked by a single rope, and such rope were to break, would there not be great danger?—There would be danger arising from the train being precipitated down.

If it is the opinion of Mr. Brunel, that there would be no great danger if the rope broke, and that the slightest resistance of the break would stop it dead, is not that erro-

neous?—I do not agree in that at all; I do not think any resistance would stop a train dead; it would gradually stop it.

Mr. Brunel says he has not calculated the amount of velocity that would be acquired; have you calculated the amount of velocity acquired in falling down these slopes?—Yes.

Just state what it is without any break?—A carriage or train commencing from the top of the Box Hill Incline, from a state of absolute repose, supposing it not to be propelled by any power, would at the foot of the slope have a velocity of forty-six miles an hour by gravity only, and the time of descent would be six minutes and a half. I omit the small fractions.

That is allowing the friction of nine pounds a ton?—Yes, it is.

That is assuming the train to descend with-any power whatever, and to commence from a state of rest?—Yes; and if it does not commence in a state of rest, you must add to the forty-six miles an hour the velocity that it had at the beginning.

If it was starting at the rate of twenty-miles, it would get up to sixty-six?—Yes.

Would not that be perfectly serious and formidable?—That is a matter of opinion; I am not afraid of those high velocities if the road be straight and level; but the curve which takes place in a quarter of a mile from the end of the plane would render it quite objectionable.

Quite formidable and dangerous?—Yes.

There would not be sufficient space in that quarter of a mile to correct such extreme velocity?—No, nothing like it.

Mr. Joy.—Suppose it is contended that the danger was reduced to nothing almost, because it was in cutting?—The difference only would be this, that if they were thrown off the rails, they would not be thrown over an embankment, but against the side of the cutting; there would be a difference of result likely to arise, but not a diminution of the chance of being thrown off the rails.

Mr. Locke states he descended the tunnel on the Liverpool and Manchester when the break was not applied at all; have you calculated what must be the speed there?—Supposing the waggon to descend from a state of rest at the top of the tunnel (I speak of the tunnel for goods, 1 in 48), the velocity acquired at the foot would be fifty-four miles an hour.

If Mr. Locke should represent that to be not accompanied with danger, must not it have been in consequence of previous precautions specially taken on the occasion?—Yes, oh certainly; because accidents have happened where the trains have broken loose in that tunnel, and the waggons have been all smashed to pieces.

Is there to some extent a natural tendency for the engines to get off the rails produced by the centrifugal force upon such a curve as that you have mentioned?—Yes, there is; and for that reason curves are inadmissible, except with a very large radius. When a body is moved in a circle it has a tendency to fly from the centre, and this tendency in the case of trains on a railway presses the waggons against the outside of the curve, and gives them a tendency to run over the rail on the convex side of the curve.

Does not that tendency increase in the same proportion as the square of the speed and the smallness of the radius?—Yes.

Have you calculated the effect of this curve, and the lateral tendency to run off the rails which this speed will produce?—Yes; it is a matter of very easy calculation.

First tell us with a speed of fifty miles an hour and a load of 100 tons?—The outward tendency would amount to 93 lbs. a ton; that would be 9,300 lbs. altogether; that is, with three quarters of a mile radius.

At forty miles an hour?—57 lbs. per ton; that would be 5,700 lbs. altogether.

At thirty-five miles an hour?—47 lbs. per ton; 4,700 lbs.

At thirty miles an hour?—33 lbs., or 3,300 lbs.

These different aggregates of outward pressure would be divided equally among all the parts of the train, and would not apply to any one part?—It would apply at so much per ton, according to the weight of the waggons; if the waggon was loaded with five tons, then the outward tendency would be five times 93 lbs.

Upon that waggon?—Yes.

If they were divided in a space of five feet, each one of those five feet would bear a proportion?—No, it is on the flange of the wheel; it would be divided between the two flanges of the two outward wheels, and the two outward wheels would be pressed outward with the force I allude to; each would be pressed with half the weight I have stated.

If there were ten waggons, each waggon would have a tenth of the whole; and if there were four wheels to each waggon, that tenth would be divided between the four wheels of each of those waggons?—No; it is only the two outward wheels that are affected, and it is divided between them equally.

Mr. Joy.—Does not it follow from what you have stated that a very slight addition would tend to throw the wheels off the rails?—Yes; a very slight pressure with that tendency would help them over the rails. At the junction of two rails they are very seldom flush. After they have been worked a little time one gets a little lower than the other, and the wheel coming against the cor-

ner with that pressure would give it a tendency to go over.

In your judgment, would not the danger of such a curve be extreme with respect to passenger trains from Bath to London?—Yes; I think it would be dangerous, in a train acquiring undue velocity, in descending the slope at Box Hill.

What should you consider undue velocity?—Fifty miles an hour I should consider undue velocity.

Would you consider 30 miles undue velocity?—I consider it is objectionable.

Mr. Joy.—If the Lowther Arcade has been alluded to as an illustration with reference to this tunnel, it must be considered as confined only to its similarity in point of steepness?—To its appearance; slopes upon railways have a tendency to remove the appearance of danger, and to create its reality.

What do you mean by slopes upon railways?—I mean inclines; an incline, that has no appearance of danger when you look at it, may have a great deal of real danger in it, though that inclination is one that will not be perceived by the eye.

Do you mean to say that an inclination that does not appear to be dangerous to the eye may be so in point of fact?—Yes, there are slopes on railways which, while they do not appear to have any danger whatever in their appearance, have a great deal in reality; it would not apply to such a slope as 1 in 1,000.

But some, which are nearly imperceptible, are very dangerous?—Yes.

[The witness is referred to two sections on the table.]

Were these prepared by you?—Yes. I was asked whether the summit level of the line had any necessary connexion with the power necessary to work it, and I drew these specimens to show that there might be two lines, one of which has a very high summit and the other a very low one, and yet which require the same total power to work them.

Just produce them, and explain them?—If you suppose this section, No. 1, to represent two roads, one of them consisting of one continuous slope rising 1 in 300, and then one descending slope of 1 in 300, and then another, with the same termini, consisting of six short ascending slopes of 1 in 300 interrupted by six descending slopes of 1 in 300,—I take 1 in 300 as an example merely,—the power necessary to work these would be precisely the same.

According to the plan you now hold in your hand, though the lower line, the darker line, attains so much lower a summit level than the lighter line, the same power is required to surmount the one as the other?—Yes, the one is a succession of summits, and the other one only; and to compare these it would be necessary to bring all the ascending slopes to one end, and all the descending to the other, and on comparing you would then find them the same.

Does not it follow then as an inevitable conclusion, that the mere summit level of two sections does not of itself afford any thing like a conclusive estimate of the power necessary to surmount that summit level?—Certainly not.

A plan which shall show two summit levels, one twice as high as the others, may not give any thing like a fair estimate of the power required to surmount the two?—You must not judge by the summit level, very little depends upon that.

Is it not obvious that a much higher summit level may be obtained by less power than a lower summit level, if in attaining the lower summit level you have more objectionable inclinations?—Yes, every thing depends upon the graduation.

So that if power be lost on the lower more than the higher summit level, the mere surface would be calculated much to mislead?—It would not mislead scientific men or engineers.

But to mislead a common spectator?—Yes, people not acquainted with the subject.

In the section you have exhibited, No. 1, you say the same power would be required for the two lines?—Yes.

You have another marked 2.?—Yes; in which the lower would require the greater power.

That is the lower and darker section would require a higher power than the upper?—Yes; the slopes are more steep.

Yet they both start at the same point?—Yes; and one is a higher summit level than the other.

And the sum of the ascents upon the undulating line on the last plan are greater than the sum of the ascents on the other?—That is not necessarily a test.

Is it not the case with this section?—It may be so; I have not measured it; that is not the test.

Explain how it is that less power is required to attain the higher summit?—If you add together all the perpendicular heights that the load has to be lifted in ascending, and then subduct from it all that falls upon an acclivity which is not more steep than 1 in 250, you will then get a number of perpendicular feet which the power is to overcome; but, in addition to that, it will be necessary to take those descending slopes which are more steep than 1 in 250, and allow for them as giving back so much power as they would give back if they were only 1 in 250, and then you get the number of perpendicular feet that the power is to overcome. The loss arising from steep slopes consists in this, that any descending planemore steep than 1 in 250, will only give back as much power as it would give back if it was 1 in 250; the consequence is,

there is a number of perpendicular feet lost wherever there is a steeper incline than 1 in 250.

1 in 250 is the point of rest?—That is the angle of repose.

Witness handed in the following paper:—

" *Calculation of the Amount of Mechanical Power necessary to draw a Ton from London to Bath, and from Bath to London, on the Great Western and Basing Lines, the Power being expressed in the equivalent Number of Pounds raised Three Feet high.*

" GREAT WESTERN RAILWAY.

" *London to Bath.*

		Feet.
Sum of all the rises		383
Sum of all the falls, not exceeding 1 in 250		243
		140
Fall at Box-hill, estimated at 1 in 250		51·98
To be overcome by power		88 02
	Yards.	
Distance from London to Bath	192,588	
Friction at 9 lbs. per ton in pounds raised 1 yard	1,733,292	
Power to raise 1 ton 88·02 feet	65,722	
Resistance from London to Bath in pounds raised 1 yard	1,799,014	

" *Bath to London.*

		Feet.
Sum of all the rises		864·5
Sum of all the falls, not exceeding 1 in 250		837
		27·5
Effective fall of Euston-square incline		15 91
		11·59
	Yards.	
Friction at 9 lbs. per ton in pounds raised 1 yard	1,733,292	
Power to raise 1 ton 11·59 feet	8,654	
Total resistance from Bath to London in pounds raised 1 yard	1,741,946	

" BASING LINE.—*London to Bath.*

		Feet.
Sum of all the rises		480
Sum of the falls, not exceeding 1 in 250		181
		299
Effective fall of slope 1 in 202		141·6
To be overcome by power		157·4
	Yards.	
Distance from London to Bath in yards	187,396	
Friction at 9 lbs. per ton in pounds raised 1 yard	1,686,564	
Power to raise 1 ton 157·4 feet	117,525	
Total resistance from London to Bath in pounds raised 1 yard	1,804,089	

" *Bath to London.*

	Feet.
Sum of the rises..	355
Sum of the falls..	480
Total effective fall..	125

	Yards.
Friction at 9 lbs. per ton in pounds raised 1 yard high	1,686,564
Effective aid derived from fall of 125 feet.........................	93,333
Total resistance from London to Bath in pounds raised 1 yard....	1,593,231

Mr. Talbot.—Is that taking all the slopes upon our line? — Yes; including Euston-square and the Box-plane.

Mr. Joy.—If it has been stated in evidence by Mr. Locke, that there are fewer accidents on the descending slope upon the Manchester and Liverpool Railway than upon other parts of the line, would not that answer—I do not mean intentionally—be fallacious in this respect, that the length of the line is about thirty-one miles, whereas the length of the incline is only about a mile and a half?—The fact that there are more accidents on that slope than on any other portion of the line of equal length is notorious.

You cannot fairly compare that plane with the whole line?—You cannot compare that one mile and a half with the twenty-eight miles.

Mr. Joy.—Have you some other tables marked 4, 5, 6, and 7, which you have prepared?—Yes; I wished to verify the result of the calculation, as it would be satisfactory to make them prove themselves, by making a calculation of the same thing by two different processes and formularies, so that it should be seen, that it was not only arithmetically right, but right upon principle; and I have proceeded to obtain the total mechanical power necessary to work the lines by both methods; the results coincide so nearly as to perfectly verify each other.

[The witness delivered in the tables referred to.]

Are these tables illustrative of the speed? —These tables include the speed which the road would be traversed with, subject to two different conditions; one, that the maximum speed is limited to thirty miles, and the other to forty miles an hour: they also state the length of line in yards, and the mechanical power necessary to overcome every slope.

On each line?—Yes, expressed in pounds weight raised a yard high; they also express the resistance in pounds per ton every slope, from one end to the other.

Backwards and forwards?—Yes.

What are the termini?—Euston-square and Bath.

Not Bristol in either case?—No.

Mr. Joy.—Taking the speed, in the first instance, as not exceeding thirty miles an hour for the maximum, what time would be consumed upon the Great Western from London to Bath?—From London to Bath on the Great Western would take, on that supposition of thirty miles an hour, four hours fifty-five minutes twenty-three seconds; on the Basing line, four hours fifty-nine minutes and fifty-seven seconds; and from Bath to London on the Great Western it would take four hours fifty-four minutes forty-four seconds, and on the Basing line four hours forty-three minutes forty seconds; and then both ways, backwards and forwards, on the Great Western it would take nine hours fifty minutes and seven seconds, and on the Basing, both ways, nine hours forty-three minutes and thirty-seven seconds; the difference in favour of the Basing line, six minutes and thirty seconds. This is on the supposition that the plane is 1 in 202.

Have you got the difference if it was calculated at 1 in 250?—No, I have not.

With a speed not exceeding forty miles from London to Bath?—Four hours forty-four minutes and forty-four seconds on the Great Western, and on the Basing four hours forty-nine minutes and forty-seven seconds.

Bath to London?—Four hours forty minutes and twenty-one seconds.

Basing?—Four hours twenty-eight minutes and thirty-six seconds.

London to Bath and Bath to London, the Great Western?—Nine hours twenty-five minutes and five seconds; and on the Basing, nine hours eighteen minutes and twenty-three seconds; the difference in favour of the Basing six minutes and forty-two seconds.

What rate do you assume on the level?—Twenty-five miles an hour.

Is that for the forty?—For both.

Have you got any other tables?—Yes.

Do they relate to another point of your examination?—A comparative view of the two lines with respect to their average power and their greatest resistance: the results are here brought together.

The results of the other tables are brought together?—Yes.

The witness delivers in the following papers:—

Comparative View of the Great Western and Basing Lines.

	Great Western.	Basing.
Total mechanical power necessary to work the line both ways, calculated by estimating the resistance upon each successive slope from the table of gradients, expressed in pounds weight, lifted three feet high	3,540,965	3,397,316
Difference of total mechanical power in favour of the Basing line	....	143,649
Total mechanical power necessary to work the line both ways, calculated by allowing nine pounds per ton for friction throughout the whole distance, and then estimating the power necessary to lift the load through the sum of all the rises, and the quantity of this power restored by the sum of all the falls	3,540,960	3,397,320
Difference in favour of the Basing line	....	143,640
Total length of the line in yards	192,588	187,396
Difference in favour of the Basing line	....	5,192
Average resistance of the line, worked both ways, in pounds per ton	9·1879	9·0645
Difference in favour of the Basing line	....	0·1234
Maximum resistance on ascending slopes from London to Bath in pounds per ton	35·05	17·96
Difference in favour of the Basing line	....	17·09
Maximum resistance on ascending slopes from Bath to London in pounds per ton	29·93	20·09
Difference in favour of the Basing line	....	9·84
Time of transit from London to Bath and from Bath to London, thirty miles an hour being taken as the greatest allowable speed	h. m. s. 9 50 7	h. m. s. 9 43 37
Difference in favour of the Basing line	....	0 6 30
Time of transit from London to Bath and from Bath to London, forty miles an hour being taken as the greatest allowable speed	9 30 5	9 18 23
Difference in favour of the Basing line	....	0 11 42
Length of an absolutely level line requiring the same quantity of mechanical power	Yards. 196,721	Yards. 188,739
Difference in favour of the Basing line	....	7,982
Effect of the gradients expressed in equivalent increase of length	4,133	1,343
Difference in favour of the Basing graduation	....	2,790
Comparative amount to which the power necessary to work the line both ways would be reduced if the Box-hill and Euston-square planes on the Great Western were converted into absolute levels, expressed in pounds raised one yard	3,466,586	3,397,318
Difference in favour of the Basing line	....	69,268
Greatest resistance from London to Bath, exclusive of Euston-square slope, in pounds per ton	16·27	17·95
Greatest resistance from Bath to London, exclusive of the Box-hill slope, in pounds per ton	15·53	20·06

Since the preceding calculations were made, it has been proposed to reduce the gradient of 1 in 202 on the Basing line to 1 in 250. This will alter several parts of the comparative estimate of the two lines. In the following table I have made these changes:—

Comparative View of the Great Western and Basing Lines, the Gradient of 1 *in* 202 *being supposed to be changed to* 1 *in* 250.

	Great Western.	Basing.
Total mechanical power necessary to work the line both ways	3,540,965	3,373,128
Difference of total mechanical power in favour of the Basing line	....	167,832
Total length of the line, in yards	192,588	187,396
Difference in favour of the Basing line	....	5,192
Average resistance of the line, worked both ways, in pounds per ton	9·1879	9.0000
Difference in favour of the Basing line	....	0·1879
Maximum resistance on ascending slopes from London to Bath, in pounds per ton	35·05	17·96
Difference in favour of the Basing line	....	17·09
Maximum resistance on ascending slopes from Bath to London, in pounds per ton	29·93	17·96
Difference in favour of the Basing line	....	11·97
Time of transit from London to Bath and from Bath to London, thirty miles an hour being taken as the greatest allowable speed	h. m. s. 9 50 7	h. m. s. 9 43 37
Difference in favour of the Basing line	....	0 6 30
Time of transit from London to Bath and from Bath to London, forty miles an hour being taken as the greatest allowable speed	9 30 5	9 18 23
Difference in favour of the Basing line	....	0 11 42
Length of an absolutely level line requiring the same quantity of mechanical power	Yards. 196,721	Yards. 187,396
Difference in favour of the Basing line	....	9,325
Effect of the gradients expressed in equivalent increase of length	4,133	—
Difference in favour of the Basing graduation		4,133
Comparative amount to which the power necessary to work the lines both ways would be reduced if the Box-hill and Euston-square planes on the Great Western were converted into absolute levels, expressed in pounds raised one yard	3,466,586	3,373,128
Difference in favour of the Basing line	....	93,458
Greatest resistance from London to Bath, exclusive of Euston-square slope, in pounds per ton	16·27	17·95
Greatest resistance from Bath to London, exclusive of the Box-hill slope, in pounds per ton	15·53	17·95
Average resistance from London to Bath and from Bath to London, the Box-hill and Euston-square slopes being supposed to be reduced to levels, in pounds per ton	9	9

Have you calculated the length of a line absolutely level which would be mechanically equivalent to each of the proposed lines?—I have.

What is the difference in favour of the Basing line?—The length of a line absolutely level, requiring the same mechanical power as the Great Western Line, would be 196,721 yards; and the length of a line absolutely level, equivalent mechanically to the Basing line, would be 188,739 yards. This is on the supposition that the greatest slope on the Basing line is 1 in 202, and in that case the difference would be 7,982 yards in favour of the Basing line,

Have you calculated what is the average power of traction per ton required upon each of the two lines?—Yes, I have. The average resistance of the line worked both ways expressed in pounds per ton for the Great Western is 9.1879, and for the Basing 9.0645; that is, in more popular language, it would be 9 lbs. and 19-100ths for the Great Western, and 9lbs. 6-100ths for the Basing; that is, supposing the slope to be 1 in 202, and taking into account the Euston-square slope, and the Box-hill slope, taking into account the whole line, and every thing on it.

Will you have the goodness to tell me if you have made any calculation of what force must

be applied to the break in order to prevent an increase of speed down the Box-hill slope?—The resistance that the break must exercise to oppose the descent of the load down the slope I stated to be 12lbs. per ton; then, in order to produce that, the break must be pressed upon the tire of the wheel with such a force as to give that resistance, namely, 12lbs. per ton. Now the pressure of the break upon the wheel would require to be from five to six times the amount of the resistance required, because the proportion that the actual pressure of the break bears to the resistance, supposing it to be made of such a wood as elm, will be five or six times, so that, if we want to produce a resistance of 12lbs. a ton, we must press the break upon the wheel with a force amounting to 60 or 70 lbs. a ton.

That is assuming the friction necessary to retard going down the Box-hill?—Yes.

Now give me the same answer with reference to the descent at Euston-square?—That is 1 in 86 I believe. The force down a plane of 1 in 86 would be 17 lbs. per ton, and 5 times 17 are from 85 to 90 lbs.; that would be the pressure necessary to counteract the whole resistance.

What means have you taken to verify the calculations you have made respecting the mechanical power and other matter to be satisfied of their accuracy?—In my calculations I have proceeded by two totally different processes and formularies. In the one case I have considered the resistance that the power has to overcome from one end of the line to the other by the friction; this is 9 lbs. per ton; the total effect of that is a matter of easy calculation. I then consider separately the effect of all the rises and all the falls. In every rise the moving power must lift the whole weight of the train through the number of perpendicular feet in the rise; in every fall less steep than 1 in 250 a quantity of power is got back equal to the number of perpendicular feet in the rise; in every fall more steep than 1 in 250 the quantity of power is got back equal to the number of perpendicular feet which would be found if the fall was only 1 in 250. Having computed these, I then combine them with the result of friction; the latter is 9 lbs. per ton. I add them or subtract them according as gravity assists or opposes the friction, and the result is the total mechanical power acquired to transfer the load from one end to the other, and I do this in both directions, and add the results, and get the total power both the one way and the other; that is one way of calculating. Then I made the same investigation by another totally distinct method; in this case I took all the slopes from one end of the line to the other. I take the common method of expressing the resistance to the drawing power on each slope expressed in pounds weight per ton; from that resistance and the length of the slope I obtain by a simple arithmetical process the total power required to draw a load from one end to the other of the slope. Having done this for all the slopes from one end to the other of the line, I added all the results together, and obtained the total mechanical power in both directions. Now, upon comparing the results of those two methods of calculation, you can see how nearly they coincide.

Do you find them nearly coincide?—From Bath to London there is no difference in the calculations; they agree to the last unit. On the Great Western, and from London to Bath, there is a difference of 5 lbs. in rather less than 2,000,000 lbs.; and on the Basing line, from Bath to London, a difference of 1 lb.

Can you at all account for that slight difference?—Yes? it arises most probably from a few decimal places being neglected in the one case that were taken in the other.

In the calculation you made, have you or not included the slope of 1 in 86, the Euston-square slope, and 1 in 107 at Box-hill?—I have included the power absolutely expended in working the slopes, but I have not made any allowance for the waste of power which must be incurred in whatever way these slopes are worked. If it is worked by a single rope, I have not included the power necessary to pull the rope back, or to work the rope, but the bare power necessary to draw the load on the slope.

How does it happen that the Great Western line has the effect of an ascent in both directions?—That is a very common consequence of graduation. The line at the one end may be a number of perpendicular feet below the other end, and the graduation may be such that it may have the effect of an up-hill both ways, as is the case on the Great Western; that arises from the two steep inclines. In going down those steep inclines we do not get back the power that is expended in ascending, and they do not give it back for the reason I have already stated; they can only give it back at the rate of 1 in 250. Now the acclivities are both considerably greater than this, and consequently a number of perpendicular feet of fall are lost.

Mr. Talbot.—Allow me to call your attention to this question; you have stated that in the case of the tunnel there would be so much greater power required, and that power requiring a greater proportionate quantity of combustion, that the ill effects would be produced in that proportion?—Yes, on a given quantity of air.

You did not add that. To a question, what would be the proportion of increase in the consumption of fuel, you say, as thirty to nine. "In the same proportion as the increase of power?" "Yes; I may assume that the destruction of vital air and the pro-

duction of noxious air is in the proportion to the mechanical power exerted?" Yes.

And only that?—Only that.

Then the consumption of power up the Box tunnel is as thirty to nine?—Yes; there are 30 lbs. of power to 9 lbs. on a level.

What is it the other way?—What do you mean?

Descending?—Nothing at all; there is no power used in descending.

If there be no power at all that way, may I not say that, taking it both ways upon two trips in this tunnel, I have an average of fifteen to nine?—If you put it in that way.

Is that an unfair mode of viewing it?—That depends upon the object you have in view in putting it so. The fact is, you consume no fuel in going one way, and you consume it in the proportion of thirty to nine in the other.

And this tunnel being to be used both ways, is it not fair to consider the quantity of noxious air and the destruction of vital air both ways?—Yes, provided that is the way you state it.

I want to know whether you accede to that?—I stated all the conditions, and my statement alluded to the passage of an engine up the tunnel from one end to the other. The passengers who descend being free from annoyance is no relief to the passengers ascending.

That sounds very clear and very amusing to my learned friend; but when we are upon the consumption of vital air, practically speaking, and trains working both ways, and passengers going both ways, am I not entitled to consider there is no consumption of vital air one way?—Yes.

Is it ridiculous to suppose that?—No.

Is it not an absolute fact?—Yes, it is.

Then it ought to be as fifteen to nine?—No, certainly not; not so far as regards any effect produced upon passengers.

You mean, when any effect is produced, it is as thirty to nine?—If there happened to be two trains passing at the same time in opposite directions, all the passengers coming down would receive the ill effects as the passengers going up, without any one receiving any benefit from the descent.

Do you mean to state, that with trains going both ways the consumption of vital air in the tunnel is in the proportion of thirty to nine, compared to a level?—No, not with the same number of trains, but I have alluded to a single train during its passage.

And during the ascent?—During the ascent.

Then with respect to those two trains going in different directions at the same time, the consumption of air would in this tunnel, with respect to another tunnel with the same length on a level, be as eighteen to thirty?—Yes.

In favour of the level tunnel?—Yes; but that is a thing never likely to happen.

Are you not, in your calculations of the effect of the noxious air given out, assuming that for a moment there is no draught?—Yes, I am decidedly of that opinion. I do not think that the shafts in the tunnel would be found to produce any good effect for the passing engine, though they will probably ventilate it for the next train; but the passage through will be so quick that no effective ventilation will have time to take place for the passing engine.

Should you like a tunnel a mile long without shafts?—I think that the shafts will not be found to be the best means, and my opinion is, that they must ventilate long tunnels by other means.

Have you any practical experience upon that subject?—No, and no one has any practical experience in tunnels of this great length upon slopes.

Are you sure of that?—I do not know of any; I never saw or heard of them.

A tunnel of a mile long?—Worked by locomotive on a slope; I am not aware of any.

What is the longest tunnel you have known?—I know of no tunnel a mile long worked by locomotives.

Mr. Talbot.—Should you like a tunnel of a mile long without shafts as well as one with shafts?—I have no experience upon the subject.

You are a scientific gentleman of great eminence put into the box to favour us with your opinion; I want your opinion?—My opinion I have stated already, that I apprehend shafts will not produce a material relief for the passing train; they may and probably will ventilate for the next train. In the transition of the train through a certain length of the tunnel there is not time for the ventilation to take effect. If the atmosphere in the tunnel be, as it generally will be, still, then the engine, as it draws the train through, will produce a quantity of noxious and annoying air; that air will remain immediately behind it, and the train will instantly be involved in it, and one cannot suppose that there will be time for that air to go up the chimney or shaft between the passage of the engine and the passage of the train of passengers; and my idea is, that they will be obliged to resort to artificial means to carry off the foul air.

Mr. Talbot.—Why should not the train of carriages leave it behind?—So it will, and it involves the train; it is because they do leave it behind that it involves the passengers.

Suppose it rises to the roof in a tunnel thirty feet high, how much will it be above

the train of passengers?—I cannot recollect the height of the carriages, twelve or fourteen feet.

The chimney is fifteen?—The carriages are very high; they go up a considerable height of the chimney.

There would be from fifteen to twenty feet between them and the roof of the tunnel?—Yes.

Do you think that this air is to rebound almost perpendicularly upon the train of carriages?—I have no doubt of it, from the velocity with which it comes from the chimney. I may state that there is a jet of high-pressure steam turned upwards in the chimney; it is blown out of the engine, and it is presented perpendicularly upwards in the chimney. All the high-pressure steam that works the engine is blown with prodigious violence up the chimney; this carries with it the noxious air, and they are driven against the roof of the tunnel with this force; they do not go up with their natural force of draught, but they are carried up and strike the roof with force of the steam, which is so considerable that they would come down upon the first carriage like a ball rebounding.

I want to ask you to explain one thing, which to me requires explanation. You told their lordships that the acclivity of the slope had nothing to do with the strength of an endless rope, because it balanced itself?—Yes.

I should be glad to know how you explain that?—If you put an endless rope over a pulley actually perpendicular, which is the extreme case and the greatest acclivity, and apply the power to it to put it in motion round the pulley, you will require a certain force to do it; and if you put the same rope upon a level it will require the same force, because the rope balances itself.

If there was a pulley at the top of this room, and I put a thread over it in the one case, and a nine-inch rope in the other?—I am speaking of the same rope.

You stated that the acclivity had nothing to do with the strength, from which I infer that the same rope will do; am I wrong?—No, provided it is to draw the same load—not the same load because the acclivity makes a difference in the load, but I am speaking of the rope itself—so far as the rope itself goes it balances itself.

You mean with the same strain?—Yes.

(To be concluded in our next.)

THE PATENT LAW AMENDMENT ACT.

An Act to amend the Law touching Letters Patent for Inventions.

I. Whereas it is expedient to make certain additions to and alterations in the present law touching Letters Patent for inventions, as well for the better protecting of patentees in the rights intended to be secured by such Letters Patent, as for the more ample benefit of the public from the same: be it enacted by the King's most excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, that any person who, as grantee, assignee, or otherwise, hath obtained or who shall hereafter obtain Letters Patent, for the sole making, exercising, vending, or using of any invention, may, if he think fit, enter with the Clerk of the Patents of England, Scotland, or Ireland, respectively, as the case may be, having first obtained the leave of his Majesty's Attorney-General or Solicitor-General in case of an English patent, of the Lord Advocate or Solicitor-General of Scotlond in the case of a Scotch patent, or of his Majesty's Attorney-General or Solicitor-General for Ireland in the case of an Irish patent, certified by his fiat and signature, a disclaimer of any part of either the title of the invention or of the specification, stating the reason for such disclaimer, or may, with such leave as aforesaid, enter a memorandum of any alteration in the said title or specification, not being such disclaimer or such alteration as shall extend the exclusive right granted by the said Letters Patent; and such disclaimer or memorandum of alteration, being filed by the said Clerk of the Patents, and enrolled with the specification, shall be deemed and taken to be part of such Letters Patent or such specification in all Courts whatever: Provided always, that any person may enter a caveat, in like manner as caveats are now used to be entered, against such disclaimer or alteration; which caveat being so entered shall give the party entering the same a right to have notice of the application being heard by the Attorney-General or Solicitor-General or Lord Advocate respectively: Provided also, that no such disclaimer or alteration shall be receivable in evidence in any action or suit (save and except in any proceeding by *scire facias*) pending at the time when such disclaimer or alteration was enrolled, but in every such action or suit the original title and specification alone shall be given in evidence, and deemed and taken to be the title and specification of the invention for which the Letters Patent have been or shall have been granted: Provided also, that it shall be lawful for the Attorney-General or Solicitor-General or Lord Advocate, before granting such fiat, to require the party applying for the same to advertise his disclaimer or alteration in such manner as to such Attorney-General or Solicitor-General or Lord Advocate shall seem right, and shall, if he so require such advertisement, certify in his fiat that the same has been duly made.

II. And be it enacted, That if in any suit

or action it shall be proved or specially found by the verdict of a jury that any person who shall have obtained Letters Patent for any invention or supposed invention was not the first inventor thereof, or of some part thereof, by reason of some other person or persons having invented or used the same, or some part thereof, before the date of such Letters Patent, or if such patentee or his assigns shall discover that some other person had, unknown to such patentee, invented or used the same, or some part thereof, before the date of such Letters Patent, it shall and may be lawful for such patentee or his assigns to petition his Majesty in Council to confirm the said Letters Patent, or to grant new Letters Patent, the matter of which petition shall be heard before the Judicial Committee of the Privy Council; and such Committee, upon examining the said matter, and being satisfied that such patentee believed himself to be the first and original inventor, and being satisfied that such invention or part thereof had not been publicly and generally used before the date of such first Letters Patent, may report to his Majesty their opinion that the prayer of such petition ought to be complied with, whereupon his Majesty may, if he think fit, grant such prayer; and the said Letters Patent shall be available in law and equity to give to such petitioner the sole right of using, making, and vending such invention as against all persons whatsoever, any law, usage, or custom to the contrary thereof notwithstanding: Provided, that any person opposing such petition shall be entitled to be heard before the said Judicial Committee: Provided also, that any person, party to any former suit or action touching such first Letters Patent, shall be entitled to have notice of such petition before presenting the same.

III. And be it enacted, that if any action at law or any suit in equity for an account shall be brought in respect of any alleged infringement of such Letters Patent heretofore or hereafter granted, or any *scire facias* to repeal such Letters Patent, and if a verdict shall pass for the patentee or his assigns, or if a final decree or decretal order shall be made for him or them, upon the merits of the suit, it shall be lawful for the judge before whom such action shall be tried to certify on the record, or the judge who shall make such decree or order to give a certificate under his hand, that the validity of the patent came in question before him, which record or certificate being given in evidence in any other suit or action whatever touching such patent, if a verdict shall pass, or decree or decretal order be made, in favour of such patentee or his assigns, he or they shall receive treble costs in such suit or action, to be taxed at three times the taxed costs, unless the judge making such second or other decree or order, or trying such second or other action, shall certify that he ought not to have such treble costs.

IV. And be it further enacted, that if any person who now hath or shall hereafter obtain any Letters Patent as aforesaid shall advertise in the *London Gazette* three times, and in three London papers, and three times in some country paper published in the town where or near to which he carried on any manufacture of any thing made according to his specification, or near to or in which he resides in case he carried on no such manufacture, or published in the county where he carries on such manufacture, or where he lives in case there shall not be any paper published in such town, that he intends to apply to his Majesty in Council for a prolongation of his term of sole using and vending his invention, and shall petition his Majesty in Council to that effect, it shall be lawful for any person to enter a caveat at the Council-office; and if his Majesty shall refer the consideration of such petition to the Judicial Committee of the Privy Council, and notice shall first be by him given to any person or persons who shall have entered such caveats, the petitioner shall be heard by his counsel and witnesses to prove his case, and the persons entering caveats shall likewise be heard by their counsel and witnesses; whereupon, and upon hearing and inquiring of the whole matter, the Judicial Committee may report to his Majesty that a further extension of the term in the said Letters Patent should be granted, not exceeding seven years; and his Majesty is hereby authorised and empowered, if he shall think fit, to grant new Letters Patent for the said invention for a term not exceeding seven years after the expiration of the first term, any law, custom, or usage to the contrary in anywise notwithstanding: Provided that no such extension shall be granted if the application by petition shall not be made and prosecuted with effect before the expiration of the term originally granted in such Letters Patent.

V. And be it enacted, that in any action brought against any person for infringing any Letters Patent the defendant on pleading thereto shall give to the plaintiff, and in any *scire facias* to repeal such Letters Patent the plaintiff shall file with his declaration, a notice of any objections on which he means to rely at the trial of such action, and no objection shall be allowed to be made in behalf of such defendant or plaintiff respectively at such trial unless he prove the objections stated in such notice: Provided always, that it shall and may be lawful for any judge at chambers, on summons served by such defendant or plaintiff on such plaintiff or defendant respectively to show cause why he

should not be allowed to offer other objections whereof notice shall not have been given as aforesaid, to give leave to offer such objections, on such terms as to such judge shall seem fit.

VI. And be it enacted, that in any action brought for infringing the right granted by any Letters Patent, in taxing the costs thereof regard shall be had to the part of such case which has been proved at the trial, which shall be certified by the judge before whom the same shall be had, and the costs of each part of the case shall be given according as either party has succeeded or failed therein, regard being had to the notice of objections, as well as the counts in the declaration, and without regard to the general result of the trial.

VII. And be it enacted, that if any person shall write, paint, or print, or mould, cast, or carve, or engrave or stamp, upon any thing made, used, or sold by him, for the sole making or selling of which he hath not or shall not have obtained Letters Patent, the name or any imitation of the name of any other person who hath or shall have obtained Letters Patent for the sole making and vending of such thing, without leave in writing of such patentee or his assigns, or if any person shall upon such thing, not having been purchased from the patentee or some person who purchased it from or under such patentee, or not having had the license or consent in writing of such patentee or his assigns, write, paint, print, mould, cast, carve, engrave, stamp, or otherwise mark the word "Patent," the words "Letters Patent," or the words "By the King's Patent," or any words of the like kind, meaning, or import, with a view of imitating or counterfeiting the stamp mark or other device of the patentee, or shall in any other manner imitate or counterfeit the stamp or mark or other device of the patentee, he shall for every such offence be liable to a penalty of fifty pounds, to be recovered by action of debt, bill, plaint, process, or information in any of his Majesty's Courts of Record at Westminster or in Ireland, or in the Court of Session in Scotland, one half to his Majesty, his heirs and successors, and the other to any person who shall sue for the same: Provided always, that nothing herein contained shall be construed to extend to subject any person to any penalty in respect of stamping or in any way marking the word "Patent" upon any thing made, for the sole making or vending of which a patent before obtained shall have expired.

ELECTRO-MAGNETIC PRIME MOVER.

Sir,—It was with no ordinary pleasure that I read the very interesting account in your last Number of the Rev. Mr. M'Gauley's Electro-Magnetic Motive Power, which is decidedly the best arrangement hitherto suggested for obtaining motive power by electro-magnetism.

I cannot help noticing, that this successful performance of Mr. M'Gauley, bears a striking resemblance to a speculative attempt to obtain a moving power by means of magnetism alone, which I published in your tenth volume.

The mode of action is, indeed, precisely the same in each, but the reverend gentleman has adopted an infinitely better method of reversing the poles of the magnet, acting on the pendulum, than I had. By this means, all the difficulty of obtaining efficient action is at once entirely obviated, and continuous motion obtained.

I remain, Sir,
Yours respectfully,
W. Baddeley.

London, Sept. 16, 1835.

THE COMET.

Mr. Editor,—In your 629th Number, Mr. Henderson gives your readers some papers respecting Halley's comet. The path of the comet is acknowledged to have been copied from that in the *Nautical Almanac*, "*with some corrections*." What a pity such corrections are not pointed out! In the present improved state of the *Nautical Almanac*, any *corrections* must be highly useful and interesting. But is there nothing *else* copied from the *Nautical Almanac*? For my part, I can discover nothing in Mr. Henderson's table that is *not* copied but its errors—and these are the entire column of meridian altitudes, and the entire omission in the column of declinations of all information as to whether they are north or south, or both or neither; in fact, the whole table (with these exceptions) is copied or rather interpolated (for the dates are ingeniously made different) from that given in the *Nautical Almanac* for 1833, and again in that for 1835, from which, had it been directly copied into your Magazine without Mr. Henderson's intervention, it would have afforded much more correct information to your readers.

Of the "Remarks" and table which

follow, I cannot discover the utility; but even this last is incorrect, for setting aside the blunder (possibly typographical) of the placing, viz. 1005 *minus* 1835 ÷ 11 = 75 years, we still have in the last term but one the following—1835 − 1682 = 153 ÷ 2, equal to 76 years even, although the other results are carried to three places of decimals.

Mr. Henderson next favours us with a statement of the comet's distance from the earth from time to time. Now, *I* am too humble to attempt to make the *original calculations* for myself, but taking the data given in the *Nautical Almanac* to be correct, the results are very different from those given by Mr. Henderson, for instance :—

1835.			According to Mr. H.
August 1st, logarithm of distance in R. A.	0·3500 = 230,000,000 miles	..	250,000,000
Sept. 1st	0·1740 = 142,000,000	....	125,000,000
Oct. 3d	9·9730 = 27,500,000	....	42,000,000
Oct. 8th, or least distance	9·3750 = 22,500,000	....	28,000,000
Nov. 17th	0·1800 = 144,000,000	....	90,000,000
Dec. 27th	0·2685 = 176,000,000	....	230,000,000

"On the 17th of November," saith Mr. Henderson, "the tail will increase in brilliancy and magnitude." So, in truth, doth Mr. Henderson's own tale, for he next lets us into the astounding secret, that it (the comet) will then (17th Nov.) be about entering the sign Gemini! Oh, Gemini!

But to crown all, Mr. Henderson, to prevent any one supposing that he had his information from an Almanac, makes an addition of 10 days to the *latest* calculated time of the comet's *perihelion* as given by other authorities, viz.

		Time of perihelion—1835.
Of the three mathematicians who have calculated the elements of Halley's comet, Lubbock gives	..	30th of October.
Damoiseau	..	4th of November.
Pontécoulant	..	7th of November.
But Mr. Henderson makes it	..	17th of November.

I trust, Mr. Editor, that you will give insertion to this letter, which is, I assure you, intended not as a reflection upon your Magazine, to which I am, and always have been, a subscriber, but as a check to would-be instructors, who aim at pretension more than at correctness. I, for one of your supporters, do not choose to be ranked amongst a class of readers who require to be told that Ursa Major means the Great Bear. Why did not Mr. Henderson, at the same time, inform us, that it also meant Charles's Wain?

I remain, Mr. Editor,
Your obedient servant,
MOHAWK.

Sept. 3, 1835.

NOTE BY MR. HENDERSON IN REPLY TO THE ABOVE.

Dear Sir,—I have perused the letter subscribed "Mohawk." With respect to the degree in which I am indebted for the calculation of Halley's comet to the *Nautical Almanac*, the word "alteration" might be read for the word "correction;" this was certainly my idea; for I do not take the *Nautical Almanac* calculation to be correct, or any thing better than an approximation to truth. There is a great share of guessing in all that has been published as to the present comet's appearance, &c. Dr. Fischer, a foreign astronomer, states, that on the 17th November the comet will enter its perihelion; Professor Airy gives the 15th November; Mr. Lubbock, in the *Nautical Almanac*, gives 30th October; Dr Damoiseau gives the 4th November, and Pontécoulant the 7th November. All these different results arise from different ideas of the extension of the cometary orbit, of the sun's distance from the perihelion and aphelion points, and of the best means of calculating these "datas" The comet was predicted to appear on 7th August (by a telescope); it did not do so for seven or eight days after, and this circumstance gave me an idea of a more expansive orbit than what had been assumed, in which case, of course, more time would be employed in coming to the perihelion I struck an average between Dr. Fischer and Professor Airy, and made out my tables accordingly. The declination and right ascension tables are made out from an estimated

value of the inclination of the cometary orbit; the right ascension from an assumed or calculated velocity given to the comet. The radii vector determines the velocity; the extent or form of the cometary orbit determines the length of the radii vector. As the radii vector increases, the comet's speed diminishes, as it decreases the speed increases, &c.

In my calculation, as published in your Journal, 17th *November* is mentioned as the day on which the comet enters Gemini. For *November* read 17th *September*, with the rest of the reading to the word "rapid."

The comet may be seen to the naked eye about 1st October.

I may mention that the circumference of the orbit of Halley's comet is about 7,250,000,000 miles; length from the aphelion to the perihelion points of its orbit, about 3,500,000,000 miles; the greatest breadth of orbit about 950,000,000 miles; the orbit extends about 1,700,000,000 miles beyond the orbit of the Georgium Sidus; which, therefore, cuts nearly the cometary orbit in equal halves; the nearest approach it makes to the sun may be taken at 56,000,000 miles (English), &c.

Dear Sir,
Yours truly,
E. HENDERSON.

Pall-Mall, Sept. 16, 1835.

ON FIRE-PROOF BUILDINGS. BY MR. CHRISTOPHER DAVY, ARCHITECT.

(In continuation from p. 457.)

Experiment 5.—*Dec.* 6, 1792.

In the front garret of the house, and in the angle of the room, to the right hand of the door (the linings and grounds of which, as well as the floor, were secured), a fierce charcoal fire was made against the linings, at half-past twelve o'clock. At a quarter before two o'clock, the bottom plate of the partition was consumed, and the fire had caught two of the joists underneath, and charred them in a small degree. At ten minutes past two the fire was extinguished, when it appeared that the upper plate of the partition of the story immediately under was on fire; the grounds and linings were consumed about 18 inches high, namely, as high as they were in contact with the fuel; the flame had ascended between the lathing on each side of the partition, and charred the quarterings, to the top, where it appeared to have been stopped in its course by the plates.

Experiment 6.

On the same day an experiment was made in the back parlour, which was secured so as to resist the strongest fire. The ceiling underneath being plated and plastered, screened dry rubbish was laid three inches deep upon the plating; it was then sound boarded, and filled, level with the joists, with rubbish, the plating laid again, and the flooring-boards laid immediately upon it. The floor above was treated in the same manner. The partitions, brick-nogged and plated on each side, were then battened out to receive the lath and plaister; a dado fixed on the partition side of the room, and prepared at the back with Mr. Wood's composition; the jambs, sill, and outside shutter of the window, plated; the door hung and double secured; and the chimney blocked up. As this room was fitted up under the direct superintendence of Mr. Hartley, and his foreman, Mr. Knight, the details contained in the Reports become particularly valuable, and are to the following purport:—

An intense fire, which filled the whole of this room, was made, by means of a tar-barrel, pitch-boards, and other equally combustible materials, and regularly fed at intervals during the space of one hour. When the outside shutter was closed, it appeared to affect the flames, so as to abate them considerably; at the same time the plaistering of the ceiling fell, and the inside of the door was consumed, thereby exposing to the flames the plating, which, however, remained whole and entire. At half-past two o'clock, the flames appeared on the outside of the door, through the rebate, at the head. At five minutes before three, the shutter was again closed, with a view to extinguish the fire. The smoke appearing through the brickwork, induced the Committee to suppose that the bond-timbers, lintels, and plates, would be consumed. At a quarter past three o'clock, the flames were got under, and the ashes and unconsumed fuel cleared out of the room, when it appeared that the flooring-boards were burnt through, in the seat of the fire, and in other places only charred; the dado was entirely gone; and the battening upon the fire-plates, to which the laths

were nailed, very much charred, as well to the sides as the ceiling. Upon taking off the plating, it appeared that the quarterings of the partition were in a good state, but in a few places the fire had charred them so as to change their colour only. The wood-bricks were also charred half an inch deep; in general, the lintel of the window did not prove to have been injured, nor the door-case; the bottom plates of the partition remained entire; upon removing the boards, the trimmer appeared to have been burnt for a foot in length by half its depth, some others appeared charred only; the adjoining rooms, and the wooden stairs, which were only separated from this room by wooden partitions, were not at all affected during the whole experiment.

Mr. Hartley and Lord Stanhope proceeded with their various experiments in a most enthusiastic manner. Both men of property, as well as men of science, they had a great advantage in this respect over many of their fellow-labourers in the cause of humanity; the experiments were upon that extensive scale that left nothing to be desired.

Having shown in what manner, and with what effect, the energies of Mr. Hartley were directed, I shall in my next enter upon a description of the plan adopted by Lord Stanhope.

C. Davy, Architect.

3, Furnival's-inn, Sept. 10, 1835.

(To be continued.)

FIRE-PROOF BUILDINGS AND THAMES TUNNEL.

Sir,—Having read with much pleasure the observations lately inserted in your Magazine upon the first of these subjects, a full investigation of which is of the most vital importance for public as well as private interest, I beg leave to offer for consideration the following plan; and at the same time would suggest the propriety of enforcing by law any plan for the protection of life and property from fire, particularly in the metropolis, that might be considered efficient.

All party-walls should be 18 inches thick, and all divisions between the front and back part of a house should be nine-inch brickwork. The joists should be of iron one inch thick, and drilled through every six inches to receive screws for fastening down the floor. I would use for the ceilings sheet-iron painted, which would form a perfectly even and durable ceiling, resisting effectually one great means of communication, in cases of fire, between the different stories. Some of the floor-screws might be passed at proper distances through the sheet-iron, the heads being neatly countersunk, and all of them are intended to screw into the underside of the floor, by passing the screw from the lower room. On the top of every house should be placed an iron tank, lined inside with lead, 3lbs. might do, having a ball-cock, and supplied by the Water Companies for domestic purposes as well as in cases of fire. The tanks should be 6 feet square by 3 feet deep, and should be so placed on the roofs, that a communication by a two-inch pipe might be made between each pair of tanks at the bottom. A pipe should descend to the bottom or ground floor and passing through the front wall under the pavement, should be inserted into a general supply three-inch pipe, the latter having at every third or fourth house a pipe two feet long rising from it, and fixed to the wall with a key tap to fix a leathern hose to when necessary, every inhabitant having a key. Such taps would in case of fire supply the engines, supposing only twelve houses formed the side of a street, with nearly eight thousand gallons of water, and the opposite houses of course the same. From the pipe that descends from the tank, should pass to each room an inch branch-pipe, having a cock 18 or 20 inches from the floor, with a key fixed to it by a chain. In case of fire breaking out in any apartment, the inmates could speedily put it out, having nearly 1300 gallons of water at their command, the produce of two tanks. I believe that if a proper supply of water were given to the tanks by the companies, those inefficient means for supplying water at fires, viz. turn-cocks and plugs could be wholly dispensed with. I do not see that it would at all interfere with such an arrangement, if the united tanks were supplied by different companies; nor do I suppose there would be any difficulty in supplying the water to the roofs of the houses in London..

The Thames Tunnel speculation appears to have excited the angry feelings of many of your contributors; and how

far this may arise from jealousy, or loss in the concern, I do not pretend to argue, but I think if it could be completed, it would very conveniently unite districts at present very far removed. To sustain the pressure of the superincumbent earth during the excavating and carrying up the brickwork, I would suggest driving, 18 inches apart, horizontally before the shield, and in a line with the top of the brickwork, iron rods an inch thick and 8 feet long; the rods to be steeled and pointed at the end which enters the earth, and to have a strong projection every six inches for the purpose of driving it on the under side; the upper side, two feet from the shield, and to have a similar projection, but placed the reverse way. A sheet of iron quarter of an inch thick, 2 feet wide by 3½ long, should then be laid over every two of the rods, butting against the end of the projections lengthways, the other end being well sharpened.

This contrivance would not be expensive, but perfectly safe and effective; and when the yard of tunnel is finished, the rods and plates could easily be driven forward a yard; 2 feet of the rods resting on the brickwork, and 3 feet in the earth in front.

I am, &c. G. L. S.

Enfield.

STREET PAVING.

Sir,—It is true, as remarked by Mr. C. Davy, at page 445, that the sketch which accompanied my notice of the new paving on Snow-hill, at page 362, is defective. The fact is, that when I first made the sketch in question, I only intended to represent the *surface* of the roadway, and in afterwards filling in the stone-work, I overlooked the real shape and position of the stones—they should have been right-angled.

Mr. Davy is right in stating that the sharp ridges of the stones would be exceedingly injurious to the knees of horses, &c. coming in contact therewith, but I am inclined to attach but little importance to this circumstance, as it will be very rarely that horses will slip or fall on such paving.

The diminished number of accidents, will, in my humble opinion, fully counterbalance the increased chance of danger, if a fall should occur. Mr. Davy suggests that this plan should be adopted at the entrance of all branch streets and gateways that have an intervening gutter, but I think he has overlooked this material circumstance, viz. that this plan is only efficiently available on inclined places, and the greater number of entrances to branch streets, &c. do not afford a sufficient rise to give due effect to this mode of paving. For such situations, perhaps, no better plan can be adopted than the one I suggested at page 319 of your fifteenth volume.

With best thanks to Mr. Davy for his correction,

I remain, yours respectfully,
W. BADDELEY.

London, Sept. 12, 1825.

P.S.—J. L.'s communication at page 248 should have been answered before this, but that many circumstances have occurred to prevent my pursuing some farther experiments illustrative of the matter at issue between us. As soon as these can be completed, you shall hear from me fully on the subject.

VIS INERTIA —WHAT IT IS.

Sir,—I have unwittingly roused the dormant faculties of your very able correspondent, Iver M'Iver, by venturing to make some observations on the subject of *vis inertia;* but I regret, and so must your readers, that the excitement was not sufficiently strong to overcome his lethargy, and induce him to go more into detail, and give his opinion on it. He has, 'tis true, given the opinions of two Cambridge professors, but he seems not to be satisfied with their arguments, and hardly to have decided on which side to vote.

Mr. Rutherfort appears to me to have the best case; and it is no trifling support to his views, that they agree in this particular with those of Sir Isaac Newton and all his followers. When a body in motion strikes another with some force, it generates in this second body the force of reaction, but it exerts itself at the moment of contact the force of indisposition to change its state, commonly called *vis inertia;* and the same name is given to the force brought into action in the second body, when no reference is made to its effect on the first. Euler, if my recollection does not deceive me, calls it the resistance to

mutual penetration, but he does not deny the existence of the actual force. It is of little consequence what name is given, provided the force is allowed. Now I should like very much to be shown what analogy there is between this case and that of the dead horse. There does not seem to me any likelihood that the force here alluded to, in whatever reform may take place in philosophy (and no doubt much is wanting), will be put into any schedule, any more than that of gravity itself.

If Professor Robinson's followers will not allow this force to have any existence, they will have ample proof, by attempting to stop by main force a train of carriages in rapid motion immediately after the steam is shut off. In this case the force is called momentum; but though the name is changed, the nature of the force remains the same. The different terms are made use of to distinguish the occasions on which the force is brought into action, one at the commencement, the other at the termination of motion. The matter which I wished to direct the attention of the parties to, was this:—If the train of carriages were moving with a velocity absolutely uniform, this force so often alluded to would be of short continuance, and have but a momentary effect; but if it were apparently, but not actually uniform, then this force to be produced by a rapid succession of minute actions and reactions, and small adjustments, would be a continuous force opposed to locomotion. And although the algebraic formula may give all the forces opposed to locomotive power accurately, what is required, is to distinguish those that are affected by gravity, and are influenced by the undulating line of railway from those that are not; for Mr. Whitehead has shown that the force generated by friction alone is not affected by it; and it is to be remarked that one force is not substituted for the other, and in lieu of it, but is an addition to it; in the same way that it was an additional force in the third case of Mr. Whitehead's; and this droll force of at times inactivity and at times activity, is alone influenced by gravity in Mr. Badnall's experiments.

I am, Sir, &c.

X. Y. Z.

SHOREHAM HARBOUR.

Sir,—As some of your readers may possess sufficient philanthropy and ability to do good, by furnishing an opinion founded upon experience, allow me the liberty of your pages, to submit a case to them that supplies an opportunity.

At the mouth of Shoreham harbour (about three miles from this place) there is a bank of sand, which operates as a barrier to the admission of vessels of a large class, and I believe to those of a medium and small class, unless at high and full tides; and the depth of water within the harbour is not always sufficient to enable a loaded vessel to get up to the quay, until she has discharged part of her cargo into barges.

The harbour's mouth is situated at about mid-distance on the western limb of a semicircular bay, and the sand-bank appears to me to be the result of the tides, south-west winds, and the want of a good scour of back water.

The Commissioners, who are more wealthy than scientific, have already spent immense sums to remedy the evil, to little or no good purpose, though it is but natural to suppose that they have endeavoured to obtain the best advice they could. If I am rightly informed, they are now about to extend the western pier a greater distance into the sea, and to leave the eastern as it is, under the idea that this will be the means of preventing a further accumulation of sand on the bar, cause a more scouring influx and reflux into the harbour's mouth, and eventually remove that which already exists. Thus far all well; but a remedy of a more extensive and costly nature seems to me requisite, to prevent the wide extension of the water, after it has obtained ingress, whereby it is allowed to deposit its filth over a large tract of land, that might be rescued for some advantage from a tidal overflow.

The best remedy that I can suggest is a concrete wall on each side, from the harbour's mouth to Shoreham on the west, and from the harbour's mouth to Copperas-gap on the east, at a suitable distance apart, so as to allow an ample ingress and egress for vessels of all sizes, and yet sufficiently near to ensure a good depth of water, which I think would soon occur by a deepening of the present channel, occasioned by the more rapid influx and reflux of the tides. For

the purpose of building such wall, an inexhaustible supply of gravel is close at hand, the neighbourhood can furnish an abundance of lime, and Brighton an ample stock of cheap pauper labour.

I should have personally suggested all this to the Commissioners, did I not well know that I might as well "whistle to the winds," as attempt to excite an attention to the subject, for "a prophet getteth no honour in his own country." It needs the opinion of some high-sounding name, accompanied by a heavy charge, to produce a desirable effect upon the minds of those who have the country's weal in charge.

I am quite conscious that the inquiry on so important a subject should proceed from some one much better acquainted with the localities of the harbour, the intentions of the Commissioners, &c. than myself; but I hope my observations may provoke some one so qualified to take up his pen, and, if so, I hope he will at the same time tell us the reason why there are no symptoms of the probability of a rail-road from the harbour's mouth to Brighton being laid down, to relieve the turnpike-road of the wear and tear, and nuisance to visitors of innumerable coal-carts, &c., and reduce the cost of carriage. The concrete wall which I have proposed, would prove an excellent groundwork for such an improvement.

Yours, &c. H.

Brighton, Sept. 9, 1835.

NOTES AND NOTICES.

Colonel Macerone and Mr. Ogle.—Sir, I had not intended to honour with any reply Mr. Ogle's jumble of vulgar personalities and perverse misrepresentations, which graces your No. 630. But I have been urged to contradict at least *one* of his *facts*, the falseness of which surprises even those who ought to know better of your lively correspondent. Mr. Ogle states and reiterates that the engines and machinery of my steam-carriage were "built by Mr. Gurney"—"bought at Gurney's auction"—"Gurney's machinery," &c.! Now this every one, who knows or cares any thing about the matter, knows to be ridiculously untrue. And Mr. Ogle knows that he has not a tittle of authority or any foundation whatever for *his* fact. Gurney's engines and machinery indeed! I, or any body else, might have had, and may still have, abundance of such for less than the price of old iron; and on this very point Mr. Ogle must have seen, if he has really read my "disgraceful pamphlet," the following passage at page 33—"Fool that I was! not to buy at the sale on the premises, in July 1832, a couple of those celebrated steam-carriages all but new (*with a separate engine to work the pumps and blower*), the last of which I saw sold for 17*l*., together with half a dozen spare boilers! I might have had the whole for less than half the money I gave for *a couple of lathes*, and a few odds and ends of 'top and bottom tools!'" This is all that ever I purchased or used of Mr. Gurney's—these lathes (three, by-the-by), and some smith's *tools*; so where did Mr. Ogle find the story of my using Gurney's machinery, &c. save in his one *inventive* imagination?—I am, &c., FRANCIS MACERONE.

Progress of the Iron Railroad System in Germany.—The road from Nuremberg to Furth will be opened this month; and from Dresden to Leipsick is in construction; that from Cologne to the Belgian frontier will probably be commenced immediately after the next meeting of the shareholders, which is fixed for the 25th inst. For those from Elberfeld to Roer, and from Elberfeld to Dusseldorf, subscriptions are opened. That from Minden to the Rhine is under consideration. Its importance, in a military point of view, leaves no doubt of its being shortly undertaken. It will unite the Weser with the Lippe, and will join the Rhine in two places (Dusseldorf and Deutz) opposite Cologne. That from Berlin to Potsdam is decided upon, and will serve as a model for the other railways in Germany. It will be laid by the best engineers of Berlin. For the roads from Berlin to Leipsick, from Berlin to Magdebourg, and from Magdebourg to Leipsick, subscriptions of 14,844,400 francs have been received, and they will be encouraged by the Prussian government. The projected railroad from Berlin to Stettin is favoured by the hereditary Prince of Prussia. The following are under consideration:—From Hanover, to the Elbe—from Bremen to Hanover—from Stuttgardt to Carmstadt—from Frankfort to Mentz—and from Mannheim to Basle. That from Neustadt, in Holstein, to Altona, has been decided upon by the Danish government. In Austria, two gigantic undertakings are in contemplation—a road from Vienna to Lemberg, in Galicia, and another from Vienna to Trieste, in the Gulf of Venice. The first will have to run in a direct line, by the map, 100 Belgian leagues, of 20 to a degree, and the second, a distance of 60 leagues.—*Paris Advertiser.*

We have given in our present Number a verbatim copy of the Patent Law Amendment Act, and shall next week offer some remarks on its practical operation. We beg in the meanwhile to state, that the Editor may be consulted, without fee or reward, on the sufficiency of any existing patent or specification, on one condition only, which may be learnt on application by letter (post paid).

Mr. Earle's letter is inconveniently long, but the object of it will perhaps be served by our mentioning that he claims the credit (?) of being the principal concoctor of the Patent Law Amendment Act, and of "piloting it triumphantly through both Houses." We thought it had been a different person, but shall not presume to dispute his positive statement to the contrary. Henceforth, then, let it be called *Earle's Bill.*

M.'s last communication with the Leeds Postmark did not reach us till after the week's Number was made up.

To E. L. S.—Banker, Darlington.

Communications received from Mr. Ryan—J. L. E.—Mr. Jos. Hayward—Mr. Davy—Dr. Clanny—H.—C. O. C.

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THE BUTTERLEY HOT-AIR SMELTING FURNACE.

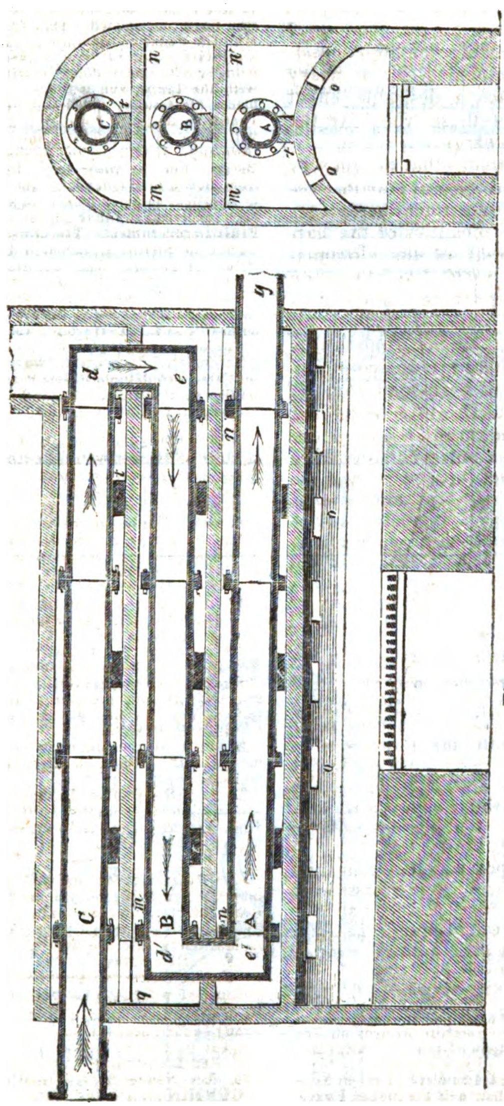


Fig. 2.

Fig. 1.

THE BUTTERLEY AND CODNOR PARK HOT-AIR SMELTING FURNACES.

The description of these furnaces, which we gave at p. 103, extracted from M. Dufresnoy's able Report on the Use of Heated Air in the Iron Works of Scotland and England, has been complained of by several of our mining friends, on account of its obscurity, arising, they say, from "the want of engravings, to show clearly the manner of construction followed at Butterley, and the improvement effected at Codnor." We now give, therefore, M. Dufresnoy's engravings of both.

Fig. 3.

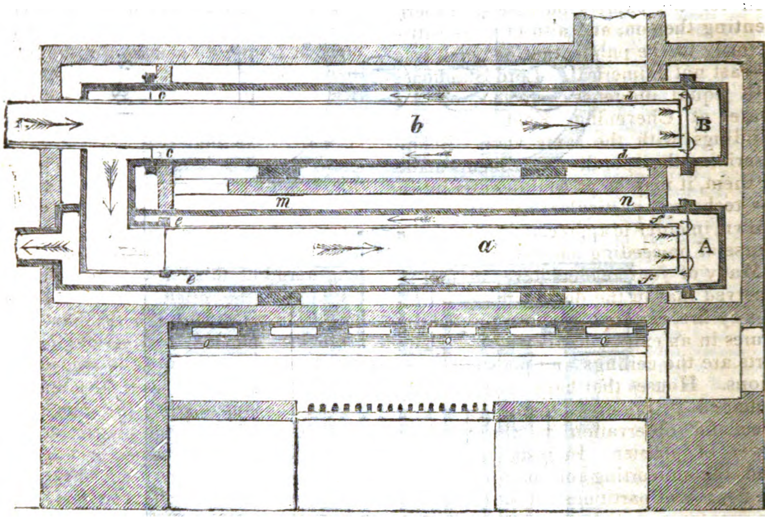


Fig. 4.

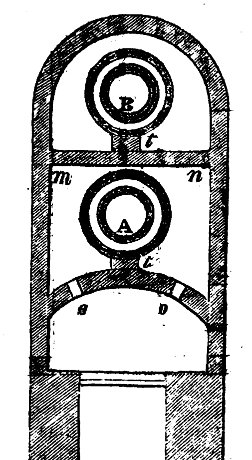


Fig. 1 is a horizontal section, and fig. 2 an end-view of the Butterley furnace. A, B, and C, are the large pipes placed one over the other, and separated by plates *m n*, *m' n'*; *d e*, *d' e'*, are the elbow-pipes which connect those larger ones. The air enters in the direction marked by the arrows, and makes its exit at *g*. At *g* and *p* are two openings, at opposite ends of the partitions *m n*, *m' n'*, to compel the hot-air to traverse the whole length without escaping from one tier to another; *t t* are the supports of the pipes A, B, and C.

Figs. 3 and 4 are analogous views of the Codnor furnace. Here there are two large pipes A and B, with smaller pipes *a b* inside of them, leaving a circular space *c d* between. The course of the hot-air is shown by the arrows.

ON FIRE-PROOF BUILDINGS. BY MR. CHRISTOPHER DAVY, ARCHITECT.

(In continuation from p. 493.)

The projectors of the two principal plans submitted to the "Association" did not feel themselves satisfied with the extent of their experiments, but, with praiseworthy zeal, entered upon another series of great magnitude. Mr. Hartley constructed a house upon Wimbledon Common for the express purpose of experimenting thereon, and also to prove satisfactorily to the public that his plan was at least not chimerical. Lord Stanhope, with equal diligence, erected on his estate at Chevening, Kent, extensive buildings with the same view. Before describing these, or the experiments made on them, it may be as well to enter into a few technical particulars necessary to be known, in order to appreciate correctly the course of proceeding adopted.

Many of your readers have, no doubt, observed that in the destruction of buildings by fire, certain parts have resisted the flames in an extraordinary degree. These parts are the ceilings and plaistered partitions. Houses that have been seriously damaged by fire are perhaps the best to select for observation on the resisting power of plaister. In instances of this kind, the supporting and main timbers of the floors and partitions will be found, for the greater part, to be totally demolished, and the plaistering will either fall or perhaps hang to the unconsumed part in one entire sheet, unless where broken by the fall of burning materials. It will naturally be asked, "How does the fire gain access to those parts that are consumed?" The answer is this:—Most rooms have a skirting against the walls continued round them, varying in height, with a moulding on the top, by way of finish, called the "base;" others, in superior apartments, are furnished in addition with what is called the "dado," the "surbase," and also "architraves" round the door-frames, to say nothing of the corresponding "grounds" and "linings." Now, in such cases, the plaistering of the partitions for either painting or papering is only continued to the top of the dado, or the top of the skirting, as the case may be. These parts are, consequently, fixed to the naked quarters or quartering of the partitions, and upon these becoming ignited, the train, if I may so speak, is immediately fired, and the usual course of destruction takes place, which is still further accelerated by the rapid current of air passing up and through the hollow space contained in the partition; partitions of this kind when plaistered are about six inches in thickness, thereby leaving an open space between the quarters of about four inches. The quarters or uprights are placed a foot or thirteen inches apart.

The resistance offered by plaister in case of fire did not escape the discernment of Lord Stanhope, and it suggested, therefore, additional means for the security of buildings. His first experiment was made in a building erected on purpose at Chevening, two stories in height, about 26 feet in length and 16 in width; this building was secured according to his plan. Adjoining this building he erected another, which was not secured; this building was upwards of 50 feet in length and of three stories in height, in the centre; he filled and covered this large building with more than 1,100 large kiln faggots, and several loads of dry shavings. His mode of *securing* was by applying a composition similar to plaistering upon laths; the composition consisting of lime, sand, plaister of Paris, brick rubbish, coal ashes, or any other materials that will form a cement when mixed with hair or chopped hay. This composition was employed as follows:—Garret story—ceiling-floor secured, rafters intersecured, down to the flooring partitions intersecured; floors, intersecured home to the party external walls; all the floors in the several stories secured in the same manner. The wooden staircases were secured immediately behind all the steps and risers, and under the flooring of the landings. In buildings where trades are carried on of a doubly or trebly hazardous nature, they should be doubly secured; and it was the opinion of the Committee that this security was proof against the strongest fire.

These explanations were given by Lord Stanhope in a paper read before the Royal Society on July 2, 1778, and published in their Transactions, vol. lxviii. part 2.

"The new and very simple method," proceeds his Lordship, "which I have discovered of securing every kind of buildings (even though constructed of timber) against all danger of fire, may very properly be divided into three parts,

namely, *underflooring*, *extra lathing*, and *intersecuring;* which particular methods may be applied in part or in whole to different buildings, according to the various circumstances attending their construction, and according to the degree of accumulated fire to which each of these buildings may be exposed from the different uses to which they are meant to be appropriated." His Lordship then goes on to state, that *underflooring* may be either single or double. Single *underflooring* is constructed in the manner following:—A common strong lath, of about a quarter of an inch thick (either oak or fir), is to be nailed against each side of every joist and of every main timber which supports the floor intended to be secured; other similar laths are then to be nailed throughout the whole length of the joists with their ends abutting each other, these are called fillets; the top of each fillet is to be one inch and a half below the top of the joists or timbers, against which they are nailed. These fillets will then form, as it were, a sort of small ledge on each side of all the joists, &c. Previous to the fillets being nailed on, some of the rough plaister (the proportions of which will be hereafter mentioned) must be spread with a trowel all along that side of each of the fillets which is to lay next the joists, in order that these fillets may be well bedded therein when they are nailed on, so that there should not be any interval between the fillets and the joists. A great number of the same description of laths must then be cut nearly to the length of the width of the interval between the joists; some of the rough plaister is then to be spread with a trowel successively upon the top of all the fillets, and along the sides of that part of the joists which is between the top of the fillets and the upper edge of the joists. These short pieces of laths are then to be placed side by side in the contrary direction to the length of the joists, so as to touch each other, or at least as much as the natural twisting of the lath will allow, and by no means to lap over each other. Their ends well bedded in the rough plaister will now rest on the fillets before mentioned. No nails ought to be used for these or other *short* pieces that may be mentioned. Supposing this to be accomplished, they ought then to be covered with one thick coat of the rough plaister, equally spread over the entire surface, and also to be brought with a trowel to be about level with the tops of the joists, but not above them; this plaistering should be left for a day or two, and then trowelled all over, but the tops of the joists should remain in their usual state.

I have now given a general description of Lord Stanhope's method of "single under-flooring," and shall proceed with the process of "double under-flooring" in my next.

I am, Sir, respectfully yours,
C. Davy, Architect.

3, Furnival's Inn, Sept. 1835.

THE GREENWICH RAILWAY.

Sir,—I cannot refrain from requesting a place in your Journal for a few observations on the last article "on Railways, by John Herapath, Esq." which appeared in the Mech. Mag. of the 12th instant. Most of the former letters of the series have called loudly enough for animadversion, but I think this exceeds them all. I believe it will not require much room nor much research to show the fallacy of almost every position advanced in the course of the remarks it contains on the merits of the Greenwich Railway.

Mr. Herapath decides without hesitation on the superiority of a range of arches to an embankment, in the case of the railway under notice; but he appears never to have bestowed a moment's consideration on the real question, whether it would not have been a better plan to conduct the railway along the surface of the ground, and so dispense with either embankment or viaduct? He himself tells us that it is to be elevated throughout its whole length, "on a viaduct 22 feet high." Nothing in favour of locomotion, therefore, is gained by raising the line, which no more *required* an embankment of 22 feet high, than a trench 22 feet deep. All that he advances, consequently, as to the "enormous expense" of such a work, might have been spared. The main advantage of the plan adopted he has entirely overlooked; *i. e.* that by its means the railway does not interfere with the thoroughfares it intersects.

The estimates of the income to be derived from the rental of the arches are most extravagant. "It is said there will

be about 1000 of them, which some calculate will fetch 30*l.* per annum each:—but suppose only 900 of them let and at 20*l.* each, the rental will be 18,000*l.* per annum, or 2000*l.* annually more than the interest of the whole capital (400,000*l.*) at 4 per cent."—Very true; but where will they find tenants at any thing like such a sum, as a ground-rent?—And a mere ground-rent it must be, for Mr. H. no where makes any provision of capital for the erection of houses.* Two of the arches, we are told, are already occupied as five-roomed private houses. Now, in what part of Bermondsey, or Deptford, are we to look for five-roomed houses, with a ground-rent of 20*l.* a-year, even in situations where a chimney may be had, and which are not subject to a continual rumbling overhead? The notion is too absurd to call for the trouble of serious refutation.

The only ground on which these estimates have been defended is, that the footpath which is to accompany the railway will be so thronged with passengers, that the arches will form first-rate situations for shops; and this, indeed, seems to be the only ground on which any rental at all (worth mentioning) can be expected for any of the arches except those close to the London Bridge-end. Mr. Herapath, however, proposes to render the situation valueless, by carrying the footpath on at the same height as the railway; and thus leaving the "shops" to which he alludes, to carry on what trade they may at a level of 22 feet below all traffic. This brings me to another of Mr. H.'s most extravagant calculations. "What would have been the consequence, says he, but the making it a favourite and fashionable promenade. And it might reasonably be expected that for every person who goes on it for business, ten would for pleasure, or health. Of course the revenue would increase in proportion; at least, if 2 or 2½ per cent. on the capital, as now calculated, be a fair estimate, five times as much, or 10 per cent. might then fairly be expected." That is, no less than *forty thousand pounds per annum* is to be derived from so insignificant a source *as a penny toll. A walk in the environs of Rotherhithe, close to the side of a railway*, crowded with smoking locomotives, is to be so attractive to the seekers after pleasure and health, that they are to rush along it at the rate of nearly *ten millions* of persons in the year!—Need a word more be said on this score?

We come now to still more amazing calculations; those of the tolls which will be payable from other railways making a partial use of the Greenwich line; and these are amazing indeed. Let Mr. H. speak for himself. "Now, the Brighton gross annual revenue is calculated, in round numbers, at 500,000*l.* Let us suppose a half of it comes in by way of Croydon, and the other goes in at the west-end of the town. Then $\frac{1}{25}$th of 250,000*l.*, which is a less proportion than it ought to be for 2½ miles on the Greenwich, gives 10,000*l.* or 2½ per cent. on the Greenwich Company's capital, for the Brighton Company's toll."

Thus, then, Mr. Herapath's mode of calculating the toll to be paid is this:—the Brighton makes use of the Greenwich line for $\frac{1}{25}$th part of the whole distance, and it must therefore pay, as toll, $\frac{1}{25}$th part of its *gross receipts!* Such an arrangement would no doubt be beneficial enough to the Greenwich Company, if their Brighton friends would but agree to it; but as the directors of the Brighton concern will not, it may be supposed, be selected from the cells of Bedlam, it is quite useless to argue upon the supposition of their doing so. As Mr. Herapath is so very ready with his calculations, perhaps he will oblige us by computing the per centage that would be realized by the Brighton Company, if they went the whole distance on railways for which they paid a toll? In other words, supposing them to pay the whole of their gross receipts to other companies for permission to use their lines, from what source would they pay the expenses of their own concern, to say nothing of the profits of so very promising an undertaking?

Mr. Herapath is determined not to be misunderstood on this point. He observes, "again, the Gravesend compute their *gross returns* at 120,000*l.*, and they run 4 miles out of 21 on the Greenwich line. We may fairly, therefore, call their quota ⅙th, or 20,000*l.* per annum, that is 5 per cent. more." There is no obscurity here, except the calling 20,000*l.* ⅙th of 120,000*l.*, which (for we must re-

* There are side walls, certainly, and perhaps a roof, formed by the arches.

collect Mr. H. is a great mathematician) may be taken for an error of the press for $\frac{1}{6}$th, thus making a very liberal allowance for the odd mile over and above the 20. With this exception, all is quite plain. The Gravesend Company wish to run $\frac{1}{6}$th of their distance on the Greenwich Railway,—they will, therefore, honestly pay the Greenwich proprietors $\frac{1}{7}$th of their receipts; not of their net receipts, be it remembered, but $\frac{1}{7}$th of their entire annual income!

And it is upon such "calculations" as this that we are to ground our faith, that the Greenwich speculation is to produce "35, 40, or 50 per cent." to the shareholders! It is to such clear-sighted individuals as this Mr. Herapath that the public are to look up for "a much fuller and clearer exposition" of its merits than mere every-day observers could give! He is, indeed, armed at all points. We have seen how satisfactorily he proves how enormous will be the Greenwich receipts;—let us now see how he disposes of that more annoying subject, the expenses.

It is generally supposed, that the keeping of a railway in repair is a serious matter. Mr. Herapath, however, soon confutes this notion, not indeed, by any abstruse calculations, but simply by observing, that it is "on such a line, a mere bagatelle,"—a very scientific and satisfactory mode of settling the question. Again, the cost of locomotive power is said to be very great. But what says our oracle: "It will be observed, that I have *omitted* the expense of locomotive power!!! The fact is, it is hardly worth noticing in so rough a calculation of per-centages." Rough, indeed, must be the calculation from which so important an item as the cost of locomotion can be omitted without derangement; although it may be conceded, that the omission of half the elements in *such* calculations as Mr. Herapath's is of no consequence. In practice, however, things are a little different. On the Liverpool and Manchester Railway, for instance, the charge for locomotive power amounts to nearly $\frac{1}{4}$th of the gross receipts; and the directors, not considering this "hardly worth notice," are straining every nerve to reduce it, and continually lamenting their inability to do so to any great extent. Their "maintenance of way" account, also, is far from being such a "bagatelle" as Mr. Herapath anticipates that of the Greenwich to be. It forms, indeed, one of the heaviest items in the long list of the expenses of a railway concern; and that these expenses, put together, are something more than a "bagatelle," will be perceived at once from the statement of the affairs of the Liverpool and Manchester Company for the last six months of 1834, given in the Mechanics' Magazine, vol. xxii. page 331, from which it appears that while the receipts were 104 899*l.*, the expenses were no less than 57,827*l.* This may, perhaps, serve to show Mr. Herapath that there is some difference between gross receipts and nett, besides convincing him that *some* expenses are not quite beneath his notice.

It would be a waste of time and patience to go through all the minor crudities of the article. Such, for instance, as the making the line of railway traverse "a beautiful country," while in another part it is truly described as "an unvaried monotonous track;" and the remark that the railway was "no doubt artfully projected to monopolize all railroads from the east and south-east of London," when of course most *eastern* lines will enter town north of the Thames. After exposing such gigantic fallacies as those relating to the rental of the arches, and, above all, to the tolls derivable from other railways; to take these minor details to pieces seems like "slaying small deer," and not worth the trouble. It would not have been worth the trouble, indeed, to notice the paper at all, were it not ushered into the world in a scientific journal, with a warm panegyric from its Editor. The series in which it appears has been from the beginning full of misapprehensions and misrepresentations, generally on no better authority than that of some casual acquaintance, whom the writer "understood" to know, or to have "heard," something of the matter. Mr Herapath, upon his own showing, has less knowledge of the subject on which he professes to enlighten the public, than would enable him to take his place in a conversation upon it; and yet he professes, and without, even then, seeking for the materials within his reach, to furnish a series of papers "on railways" to a scientific journal!

Yours, with all due respect, H.

[Having sincerely at heart on this, as on

all subjects, the cause of truth, we readily give insertion to the preceding communication, though its castigatory style is none of the most pleasant, and the Editor comes in for some hard rubs as well as his correspondent. We have the less hesitation in doing so, that the writer, though he subscribes an initial only, is known to us for a gentleman as honest of purpose as heavy of hand. We incline to think that Mr. Herapath has greatly overrated the profits of the Greenwich Railway; but we must, in justification of our editorial note of approbation, say, that it had reference rather to Mr. H.'s exposition of the various sources from which a revenue is to be derived, than to the exact sums derivable from each. We still think as highly of this undertaking as ever, and even allowing as much as H. can possibly deduct for over-calculation, there will still be a residue sufficient to allow of as handsome a profit as any person having capital to invest can reasonably desire.—Ed. M. M.]

THE NEW RIVER COMPANY.

Sir,—In my publication, entitled "Hydraulia," I have shown that the inhabitants of the metropolis often encountered difficulties and distress, from the defective supply of water, prior to the construction of the New River; and the experience of more than two centuries has demonstrated its great importance and extensive utility. However, from the complaints of the citizens residing in the ward of Aldersgate, it appears that an attempt has recently been made to diminish its benefits; and the plea urged for such a measure is, that the quantity derived from its present sources being *too scanty* for the *increased demand*, occasioned by the increase of population in the Company's district, this renders it necessary to lessen the supply in various cases!

Although it has been alleged that the project originates in *necessity*, yet, if statements made to a Committee of the House of Commons, in 1834, be deserving of belief, the New River actually furnishes such superabundance of water, as to be adequate to the supply of nearly *four* times the number of houses in the Company's district! According to that evidence, its capacity for supplying is "taken at *half* its depth; viz., two feet:" and at its average width of "*twenty-one feet*, making a section of *forty-two feet*, but it is larger in places."* Hence, if its rate of flowing be *two miles an hour*, and estimating its length at thirty-eight miles only, (but, by measurement, it was formerly found to be thirty-eight three quarter miles and eighty-eight yards,) its produce, every twenty-four hours, amounts to 65,197,440 imperial gallons. If its velocity be one mile and a half an hour, the quantity must be 48,898,080 imperial gallons; but, taking it at one mile an hour, the result will be 32,598,720 imperial gallons. The last amount being merely *half* of what the quantity ought to be, according to the width, depth, and rate of flow, named by the engineer, evinces the exuberance of the supply from this source. For the same individual also stated the average quantity daily supplied to each house was 241 gallons, which multiplied by their number, will require only 16,904,945 imperial gallons; a little less than a *moiety* of the smallest estimate, and about *one-fourth* of the quantity it yields, if his dimensions are to be relied upon!

Do not the above facts and calculations clearly prove, that the scheme of lessening the supply is not required by *necessity*, but proceeds from some other cause, which may have no better authority. Indeed, incredible as the statement may appear, the identical personage who gave the above particulars, concerning the width, depth, and velocity of the New River, to a Committee of the House of Commons, on the same occasion, asserted, that the *deficiency* of its supply rendered it an important object with the Company, to have the power of taking "*one-third* more water from the river Lea!"* Besides, at his suggestion, the Directors actually expended between 20,000*l.* and 30,000*l.* in the purchase of a mill at Tottenham, with fifty acres of land for reservoirs, &c., making surveys, having plans drawn, &c.; nay, they even applied to Parliament, at the beginning of the last session, for an Act to enable them to effect this *useless* purpose, at the cost of

* Minutes of Evidence, 1834, p. 135.

* Minutes of Evidence, 1834, p. 125.

100,000*l.*; though from the number and extent of the works contemplated, the expense would probably amount to nearer twice that sum! This, too, was alleged to have its origin in *necessity*—a scanty supply of water!

Do not the above facts inevitably lead to a conclusion rather unfavourable to the wisdom, discretion, and other qualifications, concerned in the superintendence and management of the New River establishment? Do not they also demonstrate, not only the importance, but likewise the *imperious necessity*, of the proprietors (particularly of *King's Shares*, who are totally excluded from the Direction, though possessing half the property) instituting inquiries into the motives for such costly proceedings, as well as the *enormous annual expenditure*, which has amounted to more than that of the East London, West Middlesex, Grand Junction, and Chelsea Companies *collectively*, though the three latter employ steam-engines to obtain all their water, and all of them the same kind of machinery to convey a large portion of their supply?

The table appended to my "Hydraulia," exhibits the amount of the dividends paid on each share of the several companies; and it shows, that, in general, water-works have not proved lucrative, great and obvious as is their utility to the community. Hence, the results of such enterprises afford no temptation to avaricious speculators for engaging in them. All those of the metropolis have had a long and arduous struggle to attain their present pecuniary condition, and, if competitors should arise, their success can result only from such a considerable increase of the present rate of charge, as will enable them to pay a moderate interest upon the very large capital required for such an establishment.

The sage and shrewd Dr. Franklin, among the diversity of his ingenious suggestions, proposed one for converting a *great* nation into a *little* one. This hint seems to have been adopted by the F. R. S., who so *wisely*, *skilfully*, and *courteously*, has occasioned the dissatisfaction among the citizens; and roused them to resist an attempt, which, unless more than usual knowledge and prudence shall mix in its concerns, may tend to convert the New River establishment from a *great* into a *little* one.

I am, yours, &c.
WILLIAM MATTHEWS.

MR. MALLET'S EXPERIMENTS ON THE MANUFACTURE OF WHITE OR BLEACHED PULP FOR THE PURPOSE OF MAKING PAPER FROM CERTAIN VARIETIES OF PEAT.

[We are indebted to the *Literary Gazette* for the following detailed account of Mr. Mallet's process for manufacturing paper from turf, noticed in our Report of the Proceedings of the British Association. "It was a good-humoured jest with the Irish populace," says our good-humoured contemporary, "that the Association was planning to distil the bogs into whiskey. But instead of the cup of Circe, Mr. Mallet's manipulation of them would present provision, plenty, and civilization, where now only deserts and wretchedness exist."—ED. M. M.]

A cheap and yet good substitute for hemp rags, for the purpose of affording a pulp fit for paper-making, has long been a desideratum with the manufacturer. Many attempts have been made to procure one, but the difficulties of finding one such as would suit the required conditions, and the duty and cost of hemp-rags have induced adulteration to a vast extent in the paper-manufacture. Much of the letter-paper now in use owes its apparent thickness and stiff, close texture, to an intimate admixture of the pulp or vegetable fibres with a cream of plaster of Paris or whiting. Brown paper is adulterated with ground clay, and, for similar purposes, curriers' shavings, chopped wool and hair, cotton-flyings, thistledown, and other similar materials, have been occasionally tried: but from none of them has good paper ever been made; and amongst the many experiments that have been attempted with them, being the only one that has been brought into successful use, is that of the manufacture of paper from straw, which answers tolerably for some purposes, though not for writing on, and is now made in some few places very extensively.

Under these circumstances, it appeared probable that nature might afford some vegetable fibres, of a texture sufficiently fine for making paper, and

which had never undergone any manufacturing process; and, on looking around, the *confervæ* of fresh-waters, and also certain varieties of turfs or peats, suggested themselves. The former was soon found too fragile, and its structure unfit to resist the action of the bleaching re-agents.

It is generally known that a peat-bog, and especially those of Ireland, consists of various strata, varying in density and other properties in proportion to their depth. The top surface of the bog is usually covered with living plants, chiefly mosses, heaths, and certain aquatic or paludose plants; immediately beneath this lies a stratum varying from only two or three inches to four or five feet, according to the state of drainage of the bog, of a spongy, reddish-brown, fibrous substance, consisting of the remains of vegetables, similar usually to those living on its surface, in the first stage of decomposition.

The chemical state of this stratum is nearly that of some of the papyri found in moist places in Herculaneum; that is to say, having long been exposed to the action of water, at nearly a mean temperature, the vegetable juices have nearly all been converted into ulmin-geine, or impure extractive matter, and the fibres remain nearly untouched, together, probably, with some of the essential oils of the original plants. It therefore seemed that, if these fibres, which were apparently sufficiently fine for the purpose, could be separated from their colouring matters, the object would be nearly, if not entirely attained; to this, therefore, attention was directed, and was attended with success. It is unnecessary here to enter into any detail of experiments, or into any elaborate disquisition as to the principles concerned, in making a white pulp from this material, either as regards the manufacturer or the pure chemist; presuming these to be already understood, the process may be briefly stated as follows:—

The proper description of turf being selected, is soaked in cold water until all its parts are softened, and, to a certain extent, disintegrated: it is then bruised in a suitable engine, in cold water, which is continually agitated and renewed, so that all pulverulent matter (or new dust while the turf is dry) may be washed off. The so-far cleaned fibres are then partially dried by strong pressure, in hair bags, under the hydraulic press, or by other suitable means, and then by suitable sieves and winnowing; all roots, sticks, or other gross matter incapable of being bleached, are removed. The fine, uniform, brown fibres, or rather minute stems, leaves, &c. &c. are then placed in proper vats, and digested in the cold; that is, at ordinary temperatures, with a very dilute solution of caustic, potass, or soda; preferring that made from what is called in commerce, "black potash."

After some time, nearly the whole of the geine and other extractive matter is removed, in combination with the alkali. The fibres are again pressed dry, or nearly so, from the digesting liquor, and are now found to be of a dark fawn colour, in place of their former deep red brown. They are next transferred into an exceedingly dilute sulphuric acid, containing not more than fifty grains of acid of commerce to the quart of water. They remain in this at the common temperature for some time, generally about four hours, but varying with the kind of turf; this separates the iron and earthy matters from the fibre, and carries off the adhering portions of potass and of ammonia, if any exist in the turf, which is occasionally the case. The fibres are now washed with pure cold water, until they cease to give any acid re-action, and are finally pressed nearly dry, and immersed in a dilute solution of chloride of lime; in this they remain at common temperature until sufficiently white for the purpose of the paper-maker, and, on being removed, will generally be found fine enough, as to fibre, for immediate manufacture; but, if not, are to be reduced by the ordinary rag-engine, or other suitable machinery.

By this process, it is calculated that about eighteen pounds' weight of pure white, fine pulp, may be procured from 100 weight of the raw or native turf.

Returning now to the solution of the potass, which has carried off the geine, &c., and which is chiefly, in fact, a geinate of potass; it is treated with dilute sulphuric acid, slightly in excess, and filtered through a calico or linen cloth. The potass is taken up by the acid, and the geine and extractive matter precipitate, and are collected on the

filter, from which being removed, they are dried by a steam or water-bath, and become a valuable pigment.

Vandyke brown has long been known to painters in both oil and water-colours. This is it, in fact, in its purest form; it is an extremely rich, glowing colour, and valuable for its permanence, as scarcely any agent ordinarily met with is capable of affecting it.

When once perfectly dried, it becomes insoluble in water, and, therefore, is not in the least deliquescent, but it is still soluble in alkalies; thus possessing two properties eminently fitting it for the uses of the paper-stainer and scene-painter, &c. &c. It is perfectly miscible with gum, mucilages, and with oils.

The liquid from which this colour or bistre has been separated, now contains various sulphates in solution, chiefly of iron, lime, and alumina; but the major part, sulphate of potass, or soda, whichever has been employed: if the former, Glauber's salt may be made from it, and, if the latter, alum, as matters of commerce. The quantity of alkali used is small in proportion to the amount of fluid; but if the operations were very extensive, this economical use of them should be attended to.

After the fibre has been some time digested in the solution of chloride of lime, in most cases a resinous-looking matter floats upon the surface of the fluid in very minute quantity. This, when a large quantity is operated on, may, by careful management, be collected, and is found to be a species of artificial camphor, mixed with some gum resin, and probably an essential oil. This substance, or mixture of substances, possesses some singular characters: it would seem probable, that the artificial camphor is produced by the action of some fine chlorine upon turpentine, existing in minute quantity in the turf; and it is a curious subject for reflection, that chemistry should thus, as it were, recal, into existence and decompose the turpentine existing in, and produced by, trees or plants, which have for hundreds of years ceased to have life, or to exist as vegetables. As the properties, so far as they have been ascertained, of this singular substance, are purely chemical, it is unnecessary here to detail them. It is not to be procured from every specimen of red or surface turf.

Some specimens of turf have been met with, unfit, however, for paper-making, from which it would appear to be profitable to manufacture bistre and ammonia, from the very appreciable quantity of the latter they contain.

This fibrous red surface turf, when dry, is extremely tough, and is proposed being also applied as a substitute for mill-boards, or board-paper, for the use of engineers, &c. It is capable, when dry, of immense compression by the hydraulic press; and as the fibres naturally lie nearly all in one plane, they thus arrange themselves, so as to give great toughness and flexibility to a plate of it when compressed. Accordingly, suitable masses of this turf are placed in a strong cast-iron, or other vessel, and the air exhausted; the vessel is then filled with a mixture of dilute solution of glue and molasses, at a boiling heat, which fills all the pores of the turf. The masses are then removed, while hot, and exposed to powerful pressure in a hot-press, in a similar way to hot-pressing paper, which reduces them to the required thickness, that of the original mass having been previously properly regulated. The plates so formed, are found, when cold, to be hard, tough, and flexible, and will answer almost every purpose of mill-board. They are not injured by high-pressure steam. Many other substances may be used, according to circumstances, for filling the pores, previous to pressure, as fat, oils, boiling coal-tar, wax, &c. &c.

It is worthy of remark, that the substance proposed being used for all the above processes, is the worst turf for burning; so that the material which is worst, and nearly valueless as fuel, is the best and most valuable, by a fortunate coincidence, for manufactures. If, therefore, as there is reason to believe, the lower strata of turf can, by certain modes of charring, be made a valuable fuel, and the upper and more recent strata are used for the purposes of the various manufactures above adverted to, there is a strong ground of hope that, at a future period, the bogs of Ireland, instead of being contemplated, as hitherto, as a blot and stain upon her fair and fertile champaign, may be looked

pon as one of the centres of her industry, and the richest sources of her wealth.

RECENT AMERICAN PATENTS.

(Selected from the *Franklin Journal* for August.)

Gum Elastic Sheathing for Vessels and Buildings, *George D. Cooper, New York.*—The caoutchouc or gum elastic is to be used "to prevent vessels and buildings from leaking, and to preserve the crews of vessels from the effects of dampness caused by the salting of vessels." We are told to take the material, and to "divide it and run it into sheets one quarter of an inch thick, and of such length and width as the owner or builder may elect, or else to import the sheets ready cast from Para, the place where the gum elastic is produced." These directions are more easily given than followed, and it would have been very satisfactory to have been told how to "run it into sheets" of the desired length, breadth, and thickness, without impairing its quality. To get such sheets made by the persons, and in the places, where the gum elastic is produced, would be no easy task; we, however, will suppose this to be done, or the India rubber cloth which is prepared in this country, by covering canvass on one or both sides with that material, to be substituted, therefore, agreeably to the directions of the patentee; this material is to be applied "between the inner part of the ribs, and the inner planking; between the outer part of the ribs, and the outward planking; between the outward planking and the copper; and between the deck-beams and the deck-planking." Particular directions are given for laying it on, which we need not repeat. In covering houses, the sheets are first to be laid upon rough plank, uniting their edges by dissolved gum elastic, and then shingling, or slating, over the whole, "so that the roof, &c. is not only water-tight, but air-tight." There is no claim made, but the thing intended to be secured by Letters Patent, is the interposing the gum elastic between the sheathing and other parts of vessels, and between the boards and outward covering of roofs. It may, no doubt, be very advantageously applied to some of the purposes designated, but in others the test of experience can alone determine its utility. Under shingles, for example, the retaining of the water may tend to rot them very rapidly; and it is not impossible that the agents to which it will be subjected when used under water, may operate upon it disadvantageously; it, however, is well worth the trial.

Self-operating Ink Distributer, *John Mason, Schenectady.*—Various machines have been patented for the purpose of taking the form in the common hand-press, without the aid of a second person; but, after a fair trial, they have generally been abandoned, as they are liable toget out of order, and do not execute the work as uniformly as by a roller-boy. The machine before us is spoken of as though it had no predecessors, and the end to be attained, as though it had previously been unattempted, which, as we have already intimated, is incorrect. Considerable ingenuity is manifested in the plan before us, and the machine is sufficiently novel in its construction to maintain its claim to a patent, but we do not see in it any thing calculated to obviate the objections which experience has shown to exist against those which have been tried. To describe it without the drawing would be difficult, and would interest but few of our readers.

Rotary Steam-Engine and Improved Steam Boiler, *E. Baldwin, Washington.*—The valves, four in number, are to slide into the body of a solid revolving cylinder, much in the manner of those in Bramah and Dickinson's, patented in England in the year 1790; the valves in the present instance, however, are each distinct in its operation, not being united with that which is opposite to it. These valves are to slide in and out by their own gravity, or rather, as we should suppose, they are to slide out by the centrifugal force under which they will operate, in their rapid motion, and to slide in by the action of a curved part, called by the patentee a bulk-head. Stuffing is spoken of as intended to be applied to the valves, but it is mentioned rather as a thing of experiment than of certainty.

We are left altogether to conjecture respecting what it was intended to patent, no part of the apparatus described being claimed, nor any distinction made between what is old and what is supposed to be new.

The *boiler* described is, in its general construction, like that of Stephenson, as used in locomotive-engines, but with certain specified variations. The fire-place is to be in the form of a semi-cylinder, and entirely within the horizontal cylinder constituting the boiler, its flat side being uppermost, and below the water line. Vertical tubes are to pass through the top and bottom of this fire-place, to admit water through them; and horizontal tubes, from four to six inches in diameter, are to be placed as in Stephenson' sboiler. The top of the cylinder is to have flues of sheet-iron extending along it, conducting the heated air passing through the tubes back again to the front, and then again to the back of the boiler, before it escapes at the chimney; these, of course, heat the steam only. Many advantages are enumerated, which are expected to result from a boiler so constructed, that we are very apprehensive will never be realised: we think it liable to many objec-

tions, and among them would name the vertical tubes in the fire-place, and the large size of the horizontal tubes.

PERCUSSION CANNON LOCK, *Robert Beale, Washington.*—The claim made will serve to show the intention of the patentee, which is absolutely to close the touch-hole, by holding the hammer down after the stroke. "What I principally claim, is this said cleat, or catch, which, by the aid of the spring attached to it, closes over the top of the hammer simultaneously with the explosion, and completely prevents the reaction of the hammer. The reaction of the hammer in all the locks heretofore made, has formed the objection to the percussion cannon lock."

CURRYING KNIFE TRIMMER, *Luther Townsend, Farmington.*—This currying knife is to have one flat side, and to be beviled on the other, like the edge of a chisel, instead of being, as usual, beviled on each side. The edge is to be turned towards the flat side, which is to be made perfectly smooth, and is always to remain so. "The advantage of this alteration in the shape of the knife consists in this, that it requires the turned edge to be but half as long as in the common knife with two bevils. On this plan, an edge half as long will take a rank hold of the leather, will last much longer, and will cut abundantly easier, than on the plan in common use." The trimmer is an instrument used to sharpen and smooth the edge of the knife which is turned on one side. It consists of two plates of cast-steel, fixed into a small wooden stock, by means of a wedge inserted between them, and so formed and placed, that, by drawing them over the edge of the knife, they turn a smooth edge thereon. A description of its precise form and use, would require more space than we can allot to it. We have no doubt that this instrument is a good contrivance for the intended purpose, but are unable to follow the patentee in his views, as regards his improvement in the form of the knife. We cannot see any difference in its action, whether beviled on one or on both sides. The bevil becomes a flat side by extending it to the back of the knife, and the angle of the edge may be the same, whether both sides, or only one, is beviled, and the effect produced by it must be the same in either case, although the position in which it is held must be varied.

SAUSAGE MEAT-CUTTING MACHINE, *James Burns, and John Walter, Pennsylvania.*—This bears the appearance of being a good instrument for the purpose intended, and it is certainly a very compact one. A hollow cylinder, closed at each end, has within it a revolving cylinder, or rather frustrum of a cone, extending from end to end. The meat is put into a hopper near one end of the instrument, and is discharged through an opening on the under side, near the opposite end. There is a system of fixed knives within the hollow cylinder, and upon the revolving cone are spirally placed studs, or wings, by which the meat is, in its passage, completely minced. The parts, as we have already intimated, are arranged with much skill. The claims are limited to those peculiarities in the construction, which, so far as we know, are new.

CIRCULAR SAW, *Harvey Holmes, New Marlborough.*—The sawing is to be effected by means of a hoop saw, sustained upon friction rollers, but the present patentee thinks that he has improved the apparatus, by causing the gudgeons of the friction rollers which sustain the saw, to run upon other friction rollers. He claims "the application of the second set of friction rollers, or wheels, for the journals or axles of the first-named set of friction rollers, or wheels, to run or revolve upon their surface, to prevent friction, and thereby to accelerate the speed or motion of the saw, so as to enable more work or business to be performed in the same time, than by any other machine." We are of opinion, however, that the additional friction rollers will involve more loss by their complexity, and the expense of their construction, than they will repay by diminishing friction. It will be found, in practice, that many of these wheels will stand still, and allow the gudgeons to revolve upon their surfaces, more especially when saw-dust, or other foreign matter, adheres to them.

FARMERS' MILL, *John R. Sleeper, Philadelphia.*—"A frame sufficiently strong," says the patentee, "and of any suitable materials, is made, between, or upon, the timbers of which three or more rollers of iron, or any other suitable material, are confined, and made to revolve in such a way that the grain, &c. may pass between each set of rollers. The plan best adapted to that purpose, will be to make one roller as much larger as will admit two or more small rollers to revolve in opposite directions, and with different velocities on one side of it, (something in the manner of a carding machine,) in such a way that the grain, &c. passing between or under the first roller, may, by its gravity, pass under the next roller in succession, and so on as many as may be found necessary to accomplish the desired purpose, which for Indian-corn, barley, &c., three rollers have been found sufficient. For flour, probably four, or more, will be found necessary. Adjusting screws, wedges, &c., will be found necessary, in order to set the rollers to grind fine and coarse. What I claim as my

invention, discovery, or improvement, and not previously known in the above described mill, or machine, is, applying more than two pullers, and running them at different velocities, thus adapting them to the principle of grinding grain, coffee, &c., which otherwise cannot be accomplished."

EVIDENCE OF DR. LARDNER

On the Great Western Railway Bill.

(Concluded from p. 488.)

Mr. Talbot.—Do you think, on reconsideration, that the mode of estimating the power consumed upon two relative railways, in your tables of power and speed, is a fair mode of comparison?—So far as the mechanical power is concerned, it is. I did not intend it for more than an expression of the mere mechanical power necessary to transport a certain weight from one end to the other of the railway.

Has that any thing to do with the locomotive-power required on the different railways?—Yes, every thing; it is a most material element; but there are other things to be taken into the consideration—the effects of graduation upon the particular nature of steam-power.

Is that taken into account at all in your comparison?—No; it was not intended to be in the one you allude to; it is merely mechanical power.

By a Lord.—What do you mean by mechanical power?—It is estimated by the actual amount of pull multiplied into the space through which the pull acts.

How do you arrive at it; is it a rope going over a pulley with a weight at one end?—It is a popular mode of doing it. A spring steelyard attached to a trace would indicate the intensity of the pull, and if it indicated 10 lbs. you would know that the horse was pulling 10 lbs., and the drawing-power strained in the same way as the rope with a weight of 10 lbs. suspended to it. If a horse exerts that strength through ten miles, he exerts a quantity of mechanical force equal to 100 lbs. through one mile, or if it is double that he exerts double the power.

Would not that be expressed as the power of 100?—We are accustomed to express it by a certain number of pounds raised a certain height.

There would be 100 lbs. of mechanical power expended?—Yes.

Mr. Talbot.—That is a definition that might be applied to me in lifting up this book?—Yes, in any way whatever; it is so stated in these tables.

That is upon the supposition that the power can be exactly adapted to the resistance?—It will be adapted to the resistance in spite of you; you cannot apply more power than the resistance; you may waste power, but you cannot apply it.

You say there are other ingredients not capable of numerical calculation?—There are different qualities of powers. A horse goes over an undulating road with greater advantage than a level road, if the undulations are gentle, in consequence of certain qualities in his muscles; and the best way in which a steam-engine can act is where the resistance opposed to it is invariably the same; you build an engine to meet it, and it acts with the greatest possible advantage. If you cannot get, which upon railroads you never can get, a resistance absolutely the same—in other words, an absolute level—the nearer you get to that, and the less variation the resistance is subject to, the greater the advantage in working. These are additional considerations to the total expenditure of power, but the total expenditure of power is the most material, and it cannot be omitted.

Other witnesses have stated, in the course of this inquiry, that the other ingredients in the working of locomotive-engines, compared with mechanical power, are as 4 or 5 to 1; do you agree with them?—No, certainly not. A railway may be double the length. Supposing the mechanical power necessary to draw it from one end to the other is double, then no management of the graduation could meet it; it is a question of degree.

Is not the fuel a representative of the mechanical power employed?—Unquestionably; fuel is the only thing perhaps that is precisely proportioned to it.

[A passage from the evidence of Mr. Joseph Locke is read to the witness.]

By a Lord.—Is the mechanical power you talk of represented by the expense of fuel, or what other part of the calculation?—In the mechanical power I speak of, the fuel is an article precisely proportioned to it.

If Mr. Locke was right in saying that fuel constituted $\frac{1}{5}$th only of the cost of power, does not mechanical power become an insignificant item?—If there is nothing else in the same proportion, it would be only $\frac{1}{5}$th of the importance.

What else is there?—I think the wear and tear of the engines, though not exactly in proportion, does bear a near proportion to it. A railroad that required twice as much expenditure of mechanical power might not produce twice the wear and tear, but something approximating to it.

Would not that be capable of calculation?—So far as it is capable, I would say it was double; but if the slopes were managed worse on the one than the other, it would make a difference.

Would not the original cost of the engine form a part of the calculation?—A little ad-

dition in the power is very little in the cost; it is the wear and tear of the engine, and the line, that is more important; a heavy engine will wear out a road quicker.

Is not the consumption of the boiler greater where you burn rapidly?—Yes; and a greater inclination increases the wear and tear, and a heavier engine will oftener break the rails.

By a Lord.—What do you mean by giving back power?—Suppose, in ascending a slope going in one direction, the engine is obliged to pull at the rate of 12lbs. a ton, that is, 9lbs. to overcome the natural friction of the road, and 3lbs. for gravity; in going back again the pull will be 6lbs. per ton, the gravity giving as much relief to the moving-power as it took from it in ascending; the aggregate of the up and down is, that there is no power lost at all.

It does not diminish the power necessary to take it up the slope?—No.

But in order to get over that ascent you must have a power equal to that purpose?—Having just so much less in going down.

Therefore the measure of the power must be that which will send you up the hill?—No; if you save as much moving power in coming down.

You cannot go up the hill without a certain power?—No; but you save a portion coming down.

You cannot go up without a certain pull?—No.

That is the measure of the power you must have at that place?—Yes; the pull, multiplied by the distance.

You must have power to afford it?—Yes.

The locomotive-engine, when you have acquired a power sufficient to reach the summit—does not the same power continue upon the engine throughout the whole of the line?—No; it is capable of exerting the power, but it does not exert it.

Is there any waste of power afterwards?—There is a waste of power, but it is in this way:—the engine must be built of a certain strength, and therefore of a certain weight, to be able to exert the maximum pull. That weight and strength are more than are necessary where so great a pull is not required—nevertheless, the power must carry that increased weight; but the engine does not exercise the same power on the other part of the line as up the slope.

They lessen the quantity of steam afterwards?—Yes.

We were speaking of resolving the power into $\frac{1}{5}$ths of the fuel and $\frac{4}{5}$ths of the wear and tear; the waste of power that was just mentioned applies to $\frac{4}{5}$ths, but not to $\frac{1}{5}$th?—It applies to the fuel.

There is a waste of power as to $\frac{4}{5}$ths?—No.

If you allow that proportion of the power, $\frac{1}{5}$th consists in the consumption of fuel?—No; $\frac{4}{5}$th relate to the maintenance of the men and the attendance upon the engine, not the construction of the engine only; that is one element.

The waste of power relates to the construction of the engine, being more solid and heavy than is otherwise necessary?—Yes, and the wear and tear of the line also.

In the Bath and Basing line there is one slope for six miles and three quarters at 1 in 250, the utmost upon the other being 1 in 308; would it not require an engine in proportion to the difference between the pull necessary upon those two?—Not as between those two numbers, but as the proportion of the draught upon those two planes; they will not be in the proportion of those two numbers.

Mr. Talbot.—That is $15\frac{1}{2}$ to 20?—It is $16\frac{1}{2}$ to 20.

It will require an engine of power enough to send the load up 1 in 250, and in the other to send it up 1 in 308?—Yes; which will be in the proportion of $16\frac{1}{2}$ to 18.

This is leaving out the two greatest ascents?—Yes; because they are to be worked by assistant engines.

And you leave nothing out on the other?—Yes.

Mr. Talbot.—Do you approve of using that kind of assistance?—Upon such a long slope as theirs; of 1 in 250 it would not be prudent.

Is there any unfairness in contrasting the cost of locomotive power upon any two lines, in leaving out those to be worked by an assistant engine?—No, not if you balance the disadvantages against them; if you leave out those, there will be some disadvantage on the Basing line, and you will put it against those.

Is there any comparison in practice between a short plane of 1 in 308 into a depôt and a plane of six or seven miles of 1 in 250?—The length makes no difference; you must provide an engine to exert the pull necessary.

If it is only 20 chains, do you mean to say, upon your reputation, and going into a depôt, you must have an engine of that power, just as if it was for six miles in the middle of the line?—It is necessary to explain. In ascending this slope, be it long or short, at the end or middle, it will require a certain pull; but there may be this device, whether practicable or not, I cannot say. You may make the engineer run at the foot of the slope, so that the engine will run up at an inferior pull. You are supposing a case where a power of draught is provided inferior to the resistance of the plane. I should apprehend that would be very precarious, unless it was very short.

Do you mean to adhere to the answer you formerly gave, that, no matter the situation, no matter the length of the plane, but you

must have an engine adapted to meet it?—Yes.

Is this plane of 308, of 20 chains, going into the depôt, to be compared, with respect to locomotive power necessary to work it, with a plane of six miles and three quarters in the middle of the line?—No, certainly not. It requires a great deal less locomotive power to pull it up, but a greater pull.

Will it require as much power to go up 1 in 308 for 20 chains into the depôt as 1 in 250 upon the middle of the line for six miles?—No.

An engine of the same power?—No, certainly not. I think I have explained that plainly enough. A plane of a certain inclination will require an engine to pull a load with a certain degree of tension, expressed by a certain number of pounds, which it will require whether it goes into a depôt or not, or is upon the middle of the line or not. To surmount a certain acclivity you must have a certain pull, and the engine must supply it; but if the ascent is very short, there is this possibility (it is equally applicable on every part of the line)—you may make the engine run at the foot of the plane, and it will run up by its momentum, and you need not exert that pull; so that if the plane is so short, and the momentum is sufficient to surmount it, you may do with an inferior power.

On the Bath and Basing Railway, according to your tables, I find, with all the gradients upon which you have calculated, that the result is 1,804,089 lbs., raised one yard going to Bath; do you find it so?—Yes; it is the friction from London to Bath.

What is it from Bath to London?—From Bath to London 1,593,231.

Be good enough to add those together?—They are added together somewhere; 3,397,320, that is the total of the mechanical power.

Be good enough to tell me the difference in that calculation in favour of the Bath and Basing Railway, with its present gradients, compared with the Great Western, assuming it is a dead level both ways?—The difference would be in favour of the Basing and Bath line. It is stated that on the Great Western, leaving out its gradients altogether, the total mechanical power is 3,466,584; there is no doubt it is right. The Great Western Railway, exclusive of the slopes, treating it as a level, is 3,466,584; the Bath and Basing, with its gradients, 3,397,326.

Have you compared them with your own tables?—I have. By the one it is 3,397,320; by the other, 3,397,315: if this is right, the difference is immaterial.

Mr. Talbot.—The difference is shown to be what?—69,264 yards, raised a yard.

In favour of the Bath and Basing, with all its gradients and all its slopes, as compared with the Great Western line, assumed to be a dead level?—There is no difficulty in explaining this. This calculation is made on the supposition, that the slope of 1 in 202 is reduced to 250; now I have stated, repeatedly, that every slope, the acclivity of which is not more steep than 1 in 250 (and it is well known), gives back as much power in its descent as is required in its ascent, consequently in going up and down, taking both together, it is a level as far as the mechanical power goes, and as there is no slope upon the Basing line exceeding in its acclivity 1 in 250, it is, quoad mechanical power, a level. Every line of railway which has no slope, exceeding 1 in 250, taking it both ways, and considered with reference to the expenditure of mechanical power alone, is a level.

Is not the result of your mode of calculation that if the railroad goes, no matter how often, up and down, supposing no slope downwards exceeds 1 in 250, that it is as good if not better than a level?—No, it is not as good; it is equal in respect to the mechanical power necessary to draw it, but it is not as good in respect of steam-power; it may be better in respect of horse-power; it is not so good in respect of steam-power, the lengths being the same.

Steam-power being that used for locomotives?—In steam-power the more you can equalise the resistance, *cæteris paribus*, it is better.

According to your calculations of mechanical resistance, I believe you are not far from the mark; a rise of 1,113 feet is of no importance?—It would be of importance without a corresponding fall. If the fall is not greater than 1 in 250, it will, as far as mechanical power goes, neutralise it; but not so far as steam-power is concerned; because you must have a heavier engine to go up; and there would be a waste in carrying a heavier engine. I was asked whether there would be a waste of steam upon the slopes. There will be this waste, as far as this; you must have a heavier engine, and you must have an expenditure of steam.

That would, as far as mechanical power is concerned, be the same as a level?—Yes; absolutely the same.

Where the fall compensates the rise, it is the same thing as a level mechanically?—Yes; the slopes not exceeding 1 in 250.

Where are the rises and falls upon the Great Western line, except the Box Tunnel and Euston-square, to which that applies?—There are none, if you take out the Box Tunnel and Euston square; so far as the mechanical power is concerned, it is a level.

You would look to qualify your former answer, that it is one continued line of un-

dulations?—No; it is a series of undulations.

[A diagram is handed to the witness.]

You see those two supposed railways from Bath to London; suppose them to be of equal length, which of those railways would you prefer, supposing you to be an engineer, to adopt through a country?—The level one.

Supposing that not to be quite a level, you would always select the one that approaches the nearest to it?—Yes; I have said so before.

Mr. Joy.—May there not be a higher summit level more easily attained than the lower one; in consequence of the undulations of the line?—Yes; I have stated that.

You stated, in answer to a question by my learned friend, that if the Western line were a dead level it would require a certain calculated power, and that the Basing line, when you came to compare it, required rather less. Will you tell the Committee how you account for the difference in favour of a line not a dead level?—There are neither of the lines a dead level.

My learned friend put to you the Great Western, and supposing it a dead level, how is it that the power upon your own data is more for a dead level than for the Basing, which, however good its gradients, is not a dead level?—When none of the inclinations on a line exceed 1 in 250 with respect to mechanical power, then only it is absolutely equivalent to a level, because every slope gives back as much power in going down as is used in going up. The two cases which were put to me were cases precisely of this kind. The Basing line as it stands is in that predicament; the greatest slope upon it is 1 in 250, consequently, considering mechanical power only, without reference to the power of steam, it is, to all mechanical intents and purposes, a dead level, if we consider it worked in both directions, backwards and forwards. When you desire me to regard the Western line as a dead level, putting aside the slopes at Box-hill and Euston-square, you tell me nothing, because I must regard it as a dead level, all the other slopes being less than 1 in 250, and, consequently, they were both dead levels; but the one is better than the other, being shorter.

The difference in favour of the Basing line compared with the Great Western, assuming it to be a dead level, depends wholly and exclusively upon the greater length of the Great Western?—Certainly; it is entirely owing to its comparative shortness.

You stated more than once that the best line for steam power was a dead level; the next best, that which nearest approaches to it. You have also stated that you consider mechanical power a good rough index as a measure of steam power?—As a first approximation to any power, it is a good first step, other things being afterwards taken into the account.

Then the question put by my learned friend imported a contradiction, namely, that a line not a dead level was better than one that was. Your explanation of that was, simply, that the dead level line was the longer, and the other as good as a level?—Yes: considering mechanical power only.

Suppose you were called upon to estimate the power upon two lines of road, without the slightest bias upon your mind for the one or the other, would you not have to resort to mechanical power as one of the first indices?—I would make my first approximation by it, and it would be necessary to ascertain it, whatever mode I took, because it must enter as the most important element into the calculation.

About the corruption of the air; you stated that you thought the proportion would be about 1 in 100?—Yes, nearly.

I wish you to give a familiar illustration of that proportion. Suppose a room of 10 feet high, 10 feet wide, and 10 feet long; in short, a cube of 10 feet; how many gallons of foul air would be admitted into that room to give the proportion you speak of, of 1 in 100; would it not be 62 gallons?—Yes; that would be 1 per cent.

Sixty two gallons of air in a room forming a cube of 10 feet would be about the proportion of 1 per cent.?—Yes.

Could it be denied that that would be an intolerably bad proportion for a room?—Yes, if it was a bad air; not injurious to life, but very inconvenient and unpleasant.

Would it not be so intolerable, in common parlance, that the common means for that purpose would be insufficient to dissipate it in the time that the passengers would be passing through this tunnel?—Yes, if it was offensive air; certainly.

That gives a familiar measure of the amount of bad air?—Yes, that is the proportions.

Just tell us the quantity of bad air that would be deposited:—The passage of a load of 100 tons through a tunnel of a mile and three quarters long, upon a slope of 1 in 107, would deposit in it the following quantities of noxious gases; by noxious gases, I mean gases incapable of supporting life:—carbonic acid, 1,077lbs.; azote, 2,744lbs.; sulphureous acid, an uncertain quantity; it varies with the different kinds of coke; some coke possesses it more than others; if you put down 150lbs. for that, it is not far from the mark.

What is the united weight?—I believe the ingredient of sulphur is 1 in 150 upon the weight of coke. I will just look what the weight of coke is, if you please. I do not re-

collect the quantity of oxygen with which the sulphur combines; perhaps 150lbs. is rather much for it.

I want you to give the number?—I would rather not, because it would lead people astray. There is an uncertain quantity of sulphureous acid, and a very small quantity of it is very offensive and quite intolerable.

The quantity would be how much, altogether?—About 3,900lbs. of bad air; the sulphureous acid makes no very great difference in the weight.

That is 62 gallons in a cube of 10 feet?—Yes.

My learned friend asked you, supposing the ascending train to be met by a descending train, you ought not to calculate the two together with reference to the mischief produced?—You cannot divide human suffering; one will not suffer less because another does not suffer at all.

Would not the result be rather this, that the inconvenience would be double?—The downward train will produce a slight vitiation of the air. The fire must be kept lighted, though not used; you must not let it decline, or you will not get on when you get to the foot; and, therefore, so far as the engine fire not being at work and no draught through it, so far as it consumes atmospheric air, the descending train would vitiate a portion of the air. I believe I said before the descending train would vitiate no air; I was wrong to that extent.

Assuming there were not that additional nuisance from that small portion of corrupt air generated by the descending train, there is no possibility of halving the mischief?—No.

With regard to the shafts, you stated, supposing a shaft were to be made in a very long tunnel, the passengers might suffer almost all the consequences of ill air before it would escape through the shaft?—The bad air produced by themselves; I apprehend the shaft will not ventilate it for the passing engine.

The train of passengers following right presently upon a steam engine, they would be exposed to the effects of the noxious air before it could have time to escape up the shaft?—If the air was in repose in the tunnel it would be between the shafts; at the moment of passing the shaft the engine would project the air up it; but when it had passed it, the quantity of bad air and steam emitted from the chimney issues with such prodigious force, it would rebound, and they would be involved in that air between the shafts, the air being still in the tunnel.

I believe you stated to my learned friend, that it was very possible for the undulations within a lower level to require a greater power to surmount than a higher summit level, where the undulations were not so great?—Yes, a greater mechanical power.

Might not it require a greater power in every sense of the word?—Yes; it requires a greater quantity of mechanical power; it will require greater power in every sense of the word, unless it is affected by the circumstances I have mentioned.

It is quite possible that a higher summit level should be surmounted by less power by steam-engines than a lower level, where they were injudicious undulations?—Yes, it is possible.

Might there not be a greater distance travelled within that lower summit level than up to the higher summit level, arriving by a termini common to both?—The undulations might produce a trifling increase of distance.

Would it not be possible with the same termini to give double the distance by the undulations?—Such undulations as that would be preposterous; if you speak of going over mountains, or the Peak of Teneriffe, you might make it thirty-fold.

If it has been inferred at any time, that from your calculations it is easier to go over a very mountainous country than over a dead level, is not that a very erroneous inference?—These calculations apply only to cases where the limit of the acclivities is 1 in 250, with the qualifications I have stated.

Is it not a caricature of your system to say that a high mountainous country is as good as a level, or any thing like it?—Quite so; it would not follow from any thing I have stated.

If allusions have been made to the Highlands of Scotland or the Peak of Teneriffe, it has no sort of reference to the result you produce?—What you state would follow if there were any undulations exceeding 1 in 250, taking into account both ways; but upon a railroad, between the termini of which there is no slope exceeding 1 in 250, it is for mechanical power a level, taken both ways.

That mechanical power I have understood you to say is a good general index of the general power required?—It is the best and most important approximation; other things are to be taken into account at the same time, but it forms the first approximation that any engineer and scientific man would think of making.

By the Committee.—Taking into account all the gradients, including the Box tunnel, upon the Great Western and the Euston-square plane of 1 in 86, the additional power that may be required on the one hand, or the change of power, and taking into account against the Basing the heavier engine which you have stated; which, upon the whole, do you consider the best line for steam-engine power, considering it chiefly a passenger's

railway?—I think the question is one I would answer with doubt and hesitation. We have on the Basing line the slopes of 1 in 250, which require engines capable of exerting a double power, therefore of double weight. Then there is to be taken into account the waste of power in moving that additional weight; and then there is also the increased wear and tear of the railroad, if the rails be of equal weight, or the interest of capital in making them of greater weight in order to resist the increased weight of those locomotive-engines. I do not immediately recollect any other disadvantage there is on the Basing line. Strong engines should be provided to go over those slopes with sufficient velocity for passengers; double the quantity of steam must be produced with sufficient velocity, and consequently they must be of more weight, and these precautions and disadvantages must be attended to. Then on the Western line, exclusive of the Box-hill slope and the Euston-square slope, the gradients are better, and lighter engines would answer the purpose; there would be proportionally less wear and tear of rails; there would be also less wear and tear of locomotives; these would appear to be the advantages, and the locomotives would cost a little less. Then the disadvantages of the Great Western would be the very great waste of power that must be incurred in whatever way the two slopes at Euston-square and Box-hill are worked; if by assistant locomotives, which in my opinion they must be, I am quite sure that a rope, single or endless, must be abandoned; then there is the waste of power that necessarily attends the use of such an engine as that; you must keep the fire up all day, and keep the steam roaring out of the safety-valve, always ready for action, if not, the machine cannot be brought into action when wanted to push up a train of passengers; there is this waste of power, if the locomotive is used, in each of those cases. Then, if a rope be used,—and I doubt, on consideration, whether an assistant locomotive would do upon a plane of 1 in 86, it might do, but you might be obliged to work it by a rope,—if a rope be used on either or both of those, then there will be a very large waste of power indeed in moving the rope itself; a great deal more power will be used in moving the rope than will be used in moving the load, and that is a waste of power that I have entirely left out of the account in the mechanical estimate of the two lines. Then the other disadvantage I see in the Western, compared with the Basing, is the difference of length,—the Basing is the shorter.

Do you also take into your account the much greater number of their tunnels upon this line?—I was not informed of any tunnel but the one; and it would only affect the cost of making the road.

Do you not consider tunnels generally objectionable?—Not short ones; I do not object to tunnels on a level; I would not object to any tunnel on the rest of the line; my objection is to a tunnel on a slope; no other tunnel on the line would do any harm. Then I confess I incline to think, in considering those disadvantages and advantages on both sides, that the Basing, for passengers, would certainly be the best.

You have stated the grounds on which you prefer the Basing line to the Great Western; are you aware of the different termini of the two, that the one does not reach the River Thames but by the Regent's canal, and has to go through twelve locks to it?—I have not any thing before me about the termini.

In your results you have not taken these termini as to the goods into calculation?—I have not. There is one point in the answer that has been read I would correct. It states, I incline to the opinion it would be more convenient to passengers; upon reflection, I do not know why I should limit it to passengers; I do not see any reason why I should limit it to passengers.

You think it altogether a preferable line?—Yes, I incline to that opinion.

Independently of the way in which they both reach the Thames?—Yes.

ON WATER AS A SUBSTITUTE FOR STEAM.

Mr. Editor,—On perusing Mr. Galt's "substitute for steam power," No. 629, p. 403, and the subsequent remarks of "Hydraulicus," No. 631, p. 460, I was reminded of an attempt made about two years ago by myself and an engineer, who has since constructed for me a steam-carriage, to employ water on the principle of Bramah's hydrostatic press, as a substitute for steam. My object was to propel a slow heavy carriage as a substitute for the carriers' waggons in present use. The experiment may be said to have failed: the utmost velocity that the experiment promised, supposing all intermediate difficulties could have been successfully combated, would not have exceeded a quarter of a mile an hour—too slow for my purpose. The same ideas, or some modification of them, seem to have presented themselves to Mr. Galt and to Hydraulicus. Should my experiment, and its result, possess enough of interest to entitle them to a place in the Mechanics' Magazine, you will oblige

me by inserting this paper, whilst attention is directed to the subject.

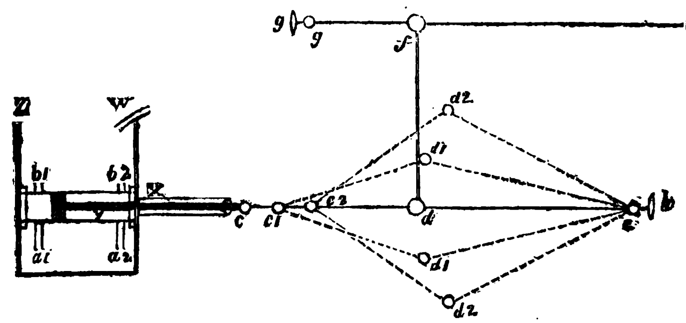
Having, in the first place, prepared a suitably strong iron stage, and an iron frame to carry a four-inch iron shaft, with a nine-inch throw crank at its centre (the same I now have in my steam-carriage); there was, in the next place, fixed upon the centre of the stage, or platform, an ordinary double-acting steam-cylinder, 12 inches diameter, 18" stroke. An ordinary sliding valve, moved by an eccentric upon the shaft, which valve I now use to govern the ingress and egress of steam, was used, on that occasion, to regulate the ingress and egress of the water. To get over the dead points, a compensating fly, just previously patented by my engineer, was added at his suggestion: this was intended to supersede the necessity of introducing a second cylinder; the motion was, however, too slow to demonstrate the utility of that fly. After the water, which was conducted from the pump into the working cylinder by a two-inch pipe, had caused the desired motion of the piston, it escaped through a two-inch eduction pipe into the tank to perform again and again the same circulation. In the tank, which was of cast-iron, and firmly fixed upon the platform or stage, was fixed a double-acting pump on the principle of De la Hire. This pump is, I presume, so well known as to need no description. In virtue of certain arrangements for working this pump, by which it was filled four times, and emptied four times, by one revolution of its lever or handle, I hoped to obtain four times the speed that could be divided from a single-acting pump: these arrangements were as is below stated. The pump was strongly fixed, horizontally, in the iron tank. The rod of its piston was restrained to perfect perpendicularity of action by a strong guide. In the parts which may be denominated the continuations of the piston-rod, was a joint just without the guide; at about 18 inches beyond this was another, a double joint, where was united, at right angles to the line of direction of the piston-rod, a rod from the lever or handle; and at about 20 inches farther was another joint near to the fulcrum, which was as firmly fixed as our ingenuity could contrive. When the machine was worked, by raising and depressing the lever or handle, the double-joint oscillated past the line of direction of the piston-rod. When the continuations of the piston-rod were in a right line, the piston was at the bottom of its stroke; when these continuations were at their extreme angle, the piston was at the top of its stroke. The piston of the pump was thus worked by an oblique leverage; such as is, I believe, regarded as the peculiar principle of the Russel printing-press. According to theory, the force moving the piston of the pump is augmentable to any extent, by shortening the oscillations of the double-joint.

By thus uniting the principle of the Russel printing-press, to be worked by a common lever—that of the double-acting pump of De la Hire, made to double its celerity of motion by an arrangement of parts of its piston-rod, and that of Bramah's hydrostatic-press, to move the piston of a common double-acting steam-cylinder, so as that as little as possible of the resulting force should be neutralised by friction, I did hope to obtain an efficient power, which might be advantageously employed to propel heavily laden, slowly moving vehicles. But the experiment failed, in as much as the motion afforded was manifestly *too slow* for the purpose. When two men were working the lever, the engineer dryly remarked, "the principle throughout is good and correct, no doubt; it only wants a steam-engine to work the pump."

If—in mechanical pursuits, *if* is often a stiffly perverse monosyllable: it sometimes sticks, like a totally insuperable obstacle, right in the way of what you would do. *If* the resulting velocity had been satisfactory, the advantages contemplated were numerous. Amongst them are the following. The stock of water, costing nothing, would have circulated somewhat like the sanguineous fluid of an animal, and lasted an indefinite time. The expenses of fuel, of repair of injuries from fire, &c. &c., to which the steam-engine is liable, would have been avoided. Almost any imaginable force, at all events any force likely to be required to propel the most heavily laden carrier's waggon up the steepest roads in England, would have been obtained from the bodily strength of two or three men, simply by shortening the oscillations of the double-joint; but the machine would have crawled more slowly. When the machine was moving upon a

plain road, or down a slight descent, the oscillations might have been augmented and the speed increased. Whilst descending the steepest declivity, the velocity could have been entirely governed, either restrained or the machine quite stopped, through the incompressibility of the water, at the will of the men working the lever.

Lest my verbal description of the pump used be unintelligible, I subjoin a rude sketch of its working parts. This, however, Mr. Editor, you are, of course, quite at liberty to suppress, if you consider that it is superfluous, or that it would be a waste of space in your valuable pages.



Z is the cast-iron water-tank; y the double-acting pump of De la Hire, strongly fixed horizontally in the tank, under water; X the guide of the piston rod; W the end of the eduction-pipe from the working cylinder, which returns the water to the tank, to be used over again; *a* 1, *a* 2, are the induction pipes of the pump, having valves opening towards the pump, or upwards. In using this pump for a common well, these pipes may be united below the valves, so that one tube only may run down into the water; *b* 1, *b* 2, are the eduction or force pipes of the pump, having valves opening from the pump, or upwards; they convey the water to the working cylinder, which is not represented. In adapting this pump to domestic uses, these pipes may be united above the valves, to form one main, which may be carried to the top of the house, if required; *c* is the first joint of the continuations of the piston rod, situated just without the guide X; *d* is the second or double joint of the continuations of the piston rod; at this point the rod *d f*, from the lever or handle, joins the piston rod at right angles; *e* is the third joint of the continuations of the piston rod, situate near the fulcrum *h*; *f* is a joint which unites the rod *d f* to the lever or handle *k*; *g* is another joint of the lever or handle, situate near its fulcrum *j*.

The fulcri *h j* being immoveably fixed, when the lever or handle *k* is raised, the double joint *d* will be moved through the point *d* 1 to *d* 2, above the line of direction of the piston rod; and when the double joint shall have attained the position of *d* 2, the piston will be drawn to the end of its stroke upwards, near the pipes *a* 2, *b* 2. By this motion the pump will be filled once, through the pipe *a* 1; and emptied once, through the pipe *b* 2. On depressing the handle or lever *k*, until it regain its original position, the double joint will travel through the point *d* 1, and attain its original position at *d*. The piston will be forced to the end of its stroke downwards, near the pipes *a* 1, *b* 1; and the pump will be discharged, for the second time, through the pipe *b* 1, and synchronously filled, for the second time, through the pipe *a* 2. On continuing the depression of the handle or lever below its present position, until the double joint *d* passes through the point *d* 1 to *d* 2, below the line of direction of the piston rod, the piston will be again drawn to the upper end of its stroke, near to the pipes *a* 2, *b* 2; and the pump will be discharged, for the third time, through the pipe *b* 2, and filled, for the third time, through the pipe *a* 1. On now raising the lever or handle until it shall have regained its original position, (when it

will have completed just one revolution,) the double joint will pass through the point d 1, below the line of direction of the piston rod, to its original position at d; and the piston will be forced again to its original position near the pipes a 1, b 1. By this motion the pump will be emptied, for the fourth time, through the pipe b 1; and filled, for the fourth time, through the pipe a 2. Thus by one revolution of the lever or handle, or by one oscllation of the double joint d, the pump will be emptied four times, and filled four times. When efficient power is to be derived from the principle of Bramah's hydrostatic-press, the expeditious filling of the working cylinder is the grand desideratum—the difficulty. In short, from the relations of the two pistons concerned, (upon which relations the power of the machine depends,) it is impossible the filling of the working cylinder can be quickly enough effected, if the power to be used is to be derived solely from the principle of the hydrostatic-press. From this circumstance arose the necessity of lessening the disproportion between the two pistons; so as, in the first place, to derive only part of the efficient force required, upon the principle of the hydrostatic-press; and, in the next place, make up in some degree by advantageous leverage, that could be worked quickly and powerfully, to impress the first impetus upon the water. This leverage seemed attainable most easily through the principle of oblique action used in the Russel printing-press; and if obstacles should arise, such as ascending a steep hill, greater than the primary force at command could overcome by full strokes of the piston, the resultant force might easily be augmented, by the employment of only the same primary force, by using half-strokes of the pump, by keeping the oscillations of the double joint between the points d 1 above and d 1 below the line of direction of the piston rod.

Although the combination of levers for working the pump was, I think, unexceptionable, and might be advantageously used on some occasions, still the experiment, on the whole, failed.

If there be any originality in the combination, I have no desire to reap any advantage from it by way of patent. I should, indeed, more desire to hinder any one else from so doing; first, by offering herein the unlimited use of it to any one who may chance to see its utility and applicability; and, secondly, by stating, that I have lately constructed another pump upon nearly the same plan. This pump, during the summer, I have had fixed half-way down in a deep well—the surface of the water being 36 feet below the surface of the earth, and I have carried the eduction pipe, or main, up to near the top of an adjoining chimney. From the main go lateral pipes, of less diameter, to coppers, sinks, dairy, &c.

This pump raised water faster than either of the cocks upon the lateral branches would deliver it, whilst subject to only the pressure of the atmosphere. The water then accumulated in the main, more or less, according to the strength and activity of the pumper. The weight of the column of water in the main, which kept augmenting only until it reached a point now to be noticed, was adding continually its pressure to the weight of atmosphere, by which the delivery was accelerated by the cocks upon the lateral branch, turned on till it attained a point of equilibrium—a point at which the cock upon the lateral branch, although of less diameter than the main, or the barrel of the pump, delivered water just as fast as the pump could raise it.

When all the cocks upon the lateral branches were turned off, the discharge up at the chimney, at the top of the main, was so profuse and forcible, that it led me to expect that, if a pump of this description were fixed in every house, and a flexible or hose pipe fitted by an union joint to the end of the main, or at some more convenient part, it might, in the case of fire in the establishment, be of considerable use as a fixed fire-engine, as well as serve the purposes of an ordinary pump for domestic uses.

KAPPA.

Sept. 21, 1835.

ON RAILWAYS. BY JOHN HERAPATH, ESQ.

NO. XI.

On the Right of Property in, and Piracy of, Railway Projections.

In a state of society so constituted as ours now is, property is a term of a most general and comprehensive signification. There was a time when the word property was solely confined to signify lands,

goods, and chattels; in short, something tangible and ponderous. But this limitation has long since passed away, and the offspring of the mind is now as much a man's property as his houses and lands are; he is even liable to be taxed to the relief of the poor for the produce of it. It is true, in common parlance, when we call such a one a man of property, we immediately understand that he is possessed of extensive lands, considerable money in the funds, or a large stock and floating capital in trade. We never certainly designate a man of great intellectual attainments or knowledge a man of property; yet, curiously enough, men claim a property in ideas, and law has sanctioned the claim. If a person hear and publish the sentiments of another for his own profit, though he had paid for the information and had heard it in common with hundreds, so jealous is the law of the author's rights, that the publisher is amenable for the publication as for a theft, unless there had been a special or implied permission to publish. This point has been settled in the celebrated case of Abernethy and the *Lancet*. Property, indeed, is now a term so very comprehensive, that it includes every thing corporeal or incorporeal which can be turned any how whatever to advantage or profit.

As fast as a new species of property rises, statutes for its protection, as they are called, are framed; but it would be much better to leave it to the protection of the common law. Thus, in literary property, what have the statutes done?—abridged the author's right from perpetuity to twenty-eight years. Have they not by this means plundered his posterity of an inheritance probably of the utmost value, which may have cost him half as long again in the labour of composition as the time allowed for his proprietary right? A man shall devote a long life to the perfection of some object which shall be an honour and ornament to his country, in which the whole human species may derive a perpetual and incalculable benefit, yet he, the author of all, is in this way, by legislative wisdom, clipped of his just reward and that equitable property in his works, which the common law would have given and secured to him. Is this, I would ask, encouragement? Is it even equity or honesty? We are told, "the common law is the perfection of reason, whose object and end are justice in the most comprehensive sense." Surely here, statute law is the perversion of reason, whose object and end are injustice on the most incomprehensible grounds.

Public interest having now been found to be deeply connected with railways, projectors, like mushrooms, have sprung up in every possible direction. Being objects of considerable profit, they are sought after with avidity. Never did phrenologist more sedulously explore the bumps and cavities of a thief or a sage's skull, than railway schemers do now the knobs and vallies of old mother Earth's surface. Smitten, I presume, with the "*amor nummi*," even some lawyers are turned railway projectors, or railway company concoctors; but of this more by-and-bye.

Probably it is not of much consequence who plans and executes railways, provided there is some regard paid to honour and honesty; for the difficulties in the executive part are rarely of an elevated character. It is, however, quite necessary to check the effrontery with which some invade the rights of others. They think, or pretend to think, because there is no statute for it, that projectors have no protection, and that every daring knave, who, by unblushing impudence and falsehood, can get together a company, may play the rook on the invention of his neighbour. This is particularly the case with a few who affect to appear before the world as the more respectable portion of the engineering profession.

It is with the view of showing these railway purloiners that they have no such privilege of self-appropriation, and cannot make these thefts with impunity, that I now call public attention to the subject, and I trust it will not be in vain. At least, I hope it will excite some one, within the circle of whose pursuits it more immediately falls, to take the matter up, and to show the public in befitting terms the gross illegality as well as injustice of such conduct. If my observations have this effect, the end will be answered and justice will be done. Men of honourable minds will see that they cannot support such schemes without contaminating their own fair characters, and will consequently find it needful to shrink from such unprincipled

plunderers, as they would from the contact of some foul fiend or midnight burglar.

Perhaps we shall not lose our labour if we examine the grounds on which these *gentlemen* defend their invasions. "Every individual," say they, "has an equal right to project a railway, and the whole country is as much open to one as to another. Consequently it follows, that A, B, C, to the end of the alphabet, have severally a common independent right to projection and execution, and there being no Act to give a preference, any one or a dozen may design the same line and get as many companies if they can." Now this reasoning is exceedingly specious, but exceedingly false. We grant that the right of projection is, in the first instance, open to all. We grant, also, that there is no statute law on the subject, and that no one has any preferable right. We will go farther: we will admit that a dozen, or a hundred if they please, may survey the same line, publish the same plan and section, and form as many companies; but then they must be independent, coexistent, and simultaneous. If any one makes his surveys and publishes his plan before another, and, at the same time, is progressing with a company, that man has a prior proprietary right, by the common law of the land, which cannot be wrested from him or invaded. "When a man," says Sir William Blackstone, speaking of literary labours, "by the exertion of his rational powers has produced an original work, he seems to have clearly a right to dispose of that individual wotk as he pleases; and any attempt to vary the disposition he has made of it, appears to be an invasion of his right." If this be true in literary works, which commonly require only the exertion of the mental faculties, how much more so is it in railway designs, which not merely require mental but great bodily exertion, and considerable expense into the bargain? The truth is, no man who has a single idea of law or justice would attempt to question it, and certainly no one who is not lost to every sense of honour and honesty would think of trying it. But some engineers, it would seem, and lawyers too, are not overloaded with honour or honesty. Possibly these terms are not in their vocabulary, or they may have in their creed an additional or eleventh commandment, which they better understand and more devoutly observe—"Take care, first of all things, of thyself; keep what thou hast, and catch what thou canst."

Bracton informs us that the common law is "universally comprehensive," excluding no kind of property whatever; and the boasted axiom of it is, that "it provides a remedy for every injury." Will any one then say that to invade the line a man has laid down and surveyed for a railway, at great labour and cost, and to endeavour to take it from him, and of course to deprive him of that fair credit and remuneration to which he is entitled. and which he may reasonably expect for his pains and expense, is not a remediable injury within the strictest sense of the word? But these railway rooks will tell you, that they have surveyed the same line, and have been at equal or greater expense than the man they oppose. True, but who gave the first idea; who made the first survey; who first published his plans? This is the man in whom the right of property is vested, if he is still occupied with the same line and has not abandoned it for another. If others have gone over the same track subsequently, knowing what he had done, and that he is still in the field, their loss must be their reward for their want of honour and manly feeling.

As to the absence of statute law on railways, they are notoriously a new subject altogether, which, happily for projectors, is not yet ripe enough for legislative interference. But that railway designs are not, therefore, without the pale of the common law, hear what Mr. Justice Willes says. "The principles of private justice, moral fitness, and public convenience," observes this learned judge, "when applied to a NEW SUBJECT, make common law without a PRECEDENT." What can be more apposite, or more conclusive? Though there is no statute law, these things are, notwithstanding, obviously within the rigid cognizance of the common law. Where else would be the "perfection of reason" which the common law assumes to be, if it afforded no protection to invention and bodily labour? Where would be the justice it professes to have for its end and object, if after a man had exhausted his mind and his means on any subject—aye, and for public convenience too—it leaves him to be robbed of his reward by every

graceless knave who has the audacity to try and the strength to do it?

To avoid the stigma of taking the identical line, some have recourse to a stratagem, which, in my opinion, is more disgraceful than a direct piracy of the line itself. They take the main features of the line and deviate here and there where it is of no consequence; and then, with all imaginable modesty, call it a new line. For instance, if it is a level open country, they will sweep off a little to the right or the left and come in again at the grand points. If a hillock intervenes they will go round one side, the original projector having gone round the other, never heeding a few feet of embankment and cutting. If the first line runs along one side of a river they will carefully take the other, feeling it delicate to encroach on the man they intend to ruin. But, wherever a town, or important village lies, or the country presents a difficulty, there their delicacy vanishes, and plump they fall into the track of the man they do not like to encroach on. So very prettily indeed do they sometimes manage it, that if the two lines were laid down on a map, it would be difficult to distinguish the piratical from the true line, unless by its graceful sinuosities about the latter. What, however, does this amount to but a colourable alteration, a paltry subterfuge, a cowardly effort to hide a theft the man is conscious of, but wants impudence or courage to defend? Give me, if I must choose, him who boldly seizes the whole. If he robs, he robs openly; but the other, like a sneaking assassin, waits his opportunity to stab that he may plunder securely. Cunning is here, however, of no avail. The law acts on a broad basis, and will protect the original plans from any colourable alteration, as much as it will from direct theft. If not, who would be safe? Between the chief points there may be several courses equally good, out of which the engineer chooses one, for he cannot have all. So, with a hill, or a river in the direction of his line, he must go on one side, he cannot go on both sides. The merit of design lies not in these minutiæ, but in the grand points taken as a whole. Would it then, for a moment, be entertained that preserving these great points, and selecting one of the unimportant, which the projector had necessarily rejected, constitute originality? The Court of Chancery would soon tell him, who might have the hardihood to try it, a different tale.

As it is obvious that two engineers may fairly and *bona fide* project lines between two towns, either at the same or different times; it may be asked, what is the test for piracy, and to what distance must one deviate from the original to escape the charge? This will depend on how far the two terminus towns are apart. If they are far asunder, it may generally be assumed, that when the lines are so projected as closely to embrace the same intermediate towns, the one is a piracy of the other, otherwise not.

I have once or twice been asked, "if a man has projected a railroad and cannot proceed with it, is he to hold the line interminably to the exclusion of others, and the prevention of the country from having a railroad?" Surely not; but a fair time must be allowed him to try his strength. He is not to be jostled out of his right, because he cannot *per saltum* get a company; nor is his chance of success to be thwarted by slander, intrigue, or dastardly machinations. If he is so treated, let him lay his case fairly before the public, and I am confident the general high character of gentlemen who support these schemes will not be appealed to in vain, nor will the authors of such conduct fail to receive their just reward.

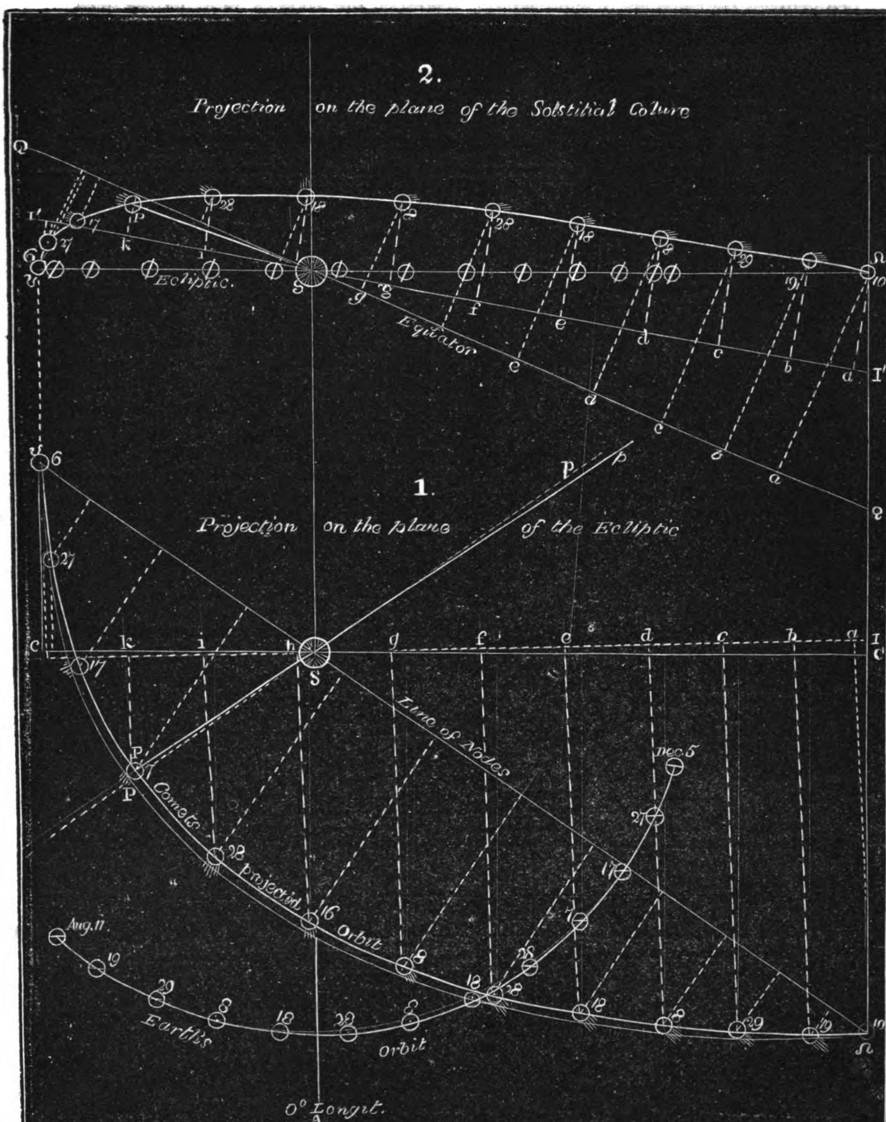
While I am on this subject I ought, perhaps, to notice the unfairness with which some engineers decry rival lines. But this is a course so pitiful and mean as usually to receive—and it is to be hoped will always insure—the full meed of unqualified contempt and immeasurable scorn.

I have only to add, that conscious of my inability to do justice to the subject of this letter, I have undertaken it merely to break the ice for others, and with the hope too, that it may induce some gentlemen to look carefully into the merits, as to originality, of the lines they are supporting, so as not to be deluded by individuals, who care but little for others, or for the character, or indeed for the success of the measure, so long it tells well for themselves.

JOHN HERAPATH.

Kensington, Sept. 1835.

GEOMETRICAL CONSTRUCTION OF THE ORBIT OF HALLEY'S COMET, WITH ILLUSTRATIONS OF ITS PHENOMENA FOUNDED THEREON. BY J. W. WOOLLGAR, ESQ.



A book of figures, such as the *Nautical Almanac*, presents to the minds even of those who profess considerable acquaintance with astronomy, but a faint idea of the phenomena which it is intended to unfold. It may be compared to a piece of written music, the mere perusal of which is completely satisfactory

only to those to whom the artificial symbols of sound are entirely and practically familiar.

To many of your readers, I apprehend, a geometrical construction founded on the recorded elements of the comet which is now engaging our attention, and an explanation by its means of the calculations which the *Nautical Almanac* exhibits, may prove interesting.

The elements are those of M. de Pontécoulant, as follows:—

	°	′
Longitude of the ascending node	55	30
Place of the perihelion *on the orbit*, 304° 31·7′—supplement	55	28·3
Sum of these two angles = angle between node and perihelion.......	110	58·3
Inclination of the orbit............	17	44·4
Ratio of eccentricity to semiaxis major	0·96752	
Semiaxis major....................	17·98705	
Motion retrograde—Epoch of perihelion, 1835, Nov. 7·193, Greenwich time.		

In fig. 1, the paper represents the plane of the ecliptic; but during a portion of the process, it is convenient to take it for the plane of the comet's orbit. In fig. 2, the paper represents a plane at right angles to the ecliptic, viz. that of the solstitial colure. These two figures, therefore, have a relation similar to that of the ground plan and elevation of a building.

The part of a comet's orbit interesting to us, is confined to the neighbourhood of the perihelion. In the present case, the portion lying between the two nodes is most convenient for our purpose. It comprises a period of 118·35 days nearly.

In order to lay down the orbit, the *radii vectores* and *anomalies* for regular intervals of time on each side of the perihelion, must be obtained—the logarithms of the former are given in the *Nautical Almanac;* the latter may be deduced by Mr. Woolhouse's method, or they may be obtained approximately from the tables of parabolic motion, and corrected for the elliptic differencs.

Having drawn C S C, and S A at right angles to it, the latter will represent the first point of Aries;—set off A S ☊ = 55° 30′, and draw ☋ S ☊ for the line of nodes; also set off ☊ S P = 110° 58·3′, and on each side of *P p* draw the *radii vectores* at the proper angles for the intervals chosen. Then through the extremities of the radii, describe the curve ☊ *P* ☋ to represent the comet's orbit *on its own plane.*

Upon the line of nodes let fall perpendiculars from the several points, and diminish each of them in the ratio of radius to cosine inclination (1 : cos. 17° 44·6); through the points thus obtained draw another curve (the inner one in the figure), which will represent the comet's orbit projected upon the plane of the ecliptic. With the mean radius of the earth's orbit describe a circle or arc sufficient to include the portion which corresponds in point of time to the period of the comet's motion through the superior part of its orbit.* Then the earth's position in its orbit for dates corresponding to the positions of the comet, are to be marked by means of its longitudes taken from an ephemeris.

For the construction of fig. 2 (to be used in connexion with the former figure), we must determine the intersection and position of the cometary plane with respect to that of the solstitial colure. This is done by resolving a right-angled spherical triangle, wherein is given one leg, viz. the complement of 55° 30′, and one angle = 17 44·4′; in the result we obtain the hypothenuse = 35° 49′, the other angle = 75° 27′, and the other leg = 10° 16′. Having then drawn a second line ☋ S′ ☊ (fig. 2) parallel to, and at a suitable distance from the former, make the angle ☊ S I′ = 10° 18′, and the angle ☊ S I (fig. 1) = 35° 49′. From the several points in the *original* orbit (not the projected one), let fall the ordinates ☊ *a*, 19 *b*, 29 *c*, 8 *d*, 18 *e*, &c. Next transfer to the line I′ S I′ (fig. 2) the distances cut off by these ordinates, measuring in every case from S′, and erect perpendicular ordinates at the several points, the lengths of all which are to be to the corresponding ordinates in fig. 1 as radius to the cosine of 75° 27′. The summit of the first of these ordinates will fall upon ☋ S′ ☊ ; and a curve being drawn from thence through the other ordinates, will represent the comet's orbit, as seen by an eye placed in the plane of the ecliptic at an infinite distance in the direction S A. Upon the same principle, if perpendicu-

* The scale of my original figure was five inches for the earth's mean distance, and the comet's places on the orbit marked for every four days; it has been reduced for engraving to two inches, and the intervals extended to ten days to avoid confusion.

* This circle or arc must be made eccentric to the sun, by placing its centre at 0·0168 from the sun's, in the direction of long. 280°.

lars be let fall from the points of the earth's orbit upon the line S A, and their lengths severally set off on the line ♑ S ☊ in fig. 2, the points so determined will represent the earth's several positions on the vertical plane relatively to those of the comet before exhibited.

So far we have proceeded with reference to the ecliptic. But, in modern times, a reference to the plane of the equator has gradually obtained the preference over the ancient method. Now since the equator and ecliptic are both perpendicular to the solstitial colure, their angle of intersection will be represented in fig. 2 by its true value. Therefore, making the angle ☊ S′Q=23° 27 7′, the line Q S′Q will represent the intersection of a plane passing through the sun's centre, and parallel at all times to the earth's equator. Then, if we draw from the comet's orbit the ordinates ☊ a, 19 b, 29 *c*, 8 *d*, 18 *e*, &c., they will be equal to the values denoted by the letter *z* in the table of co-ordinates (*Nautical Almanac*, 1835, p. 491), and the corresponding abscissas, S a, S b, S c, &c., will be the values denoted by the letter *y*. Moreover, if in fig. 1, ordinates be demitted from the *projected* orbit, upon the line ♑S☊, they will exhibit the values denoted by the letter *x*. By proceeding similarly, in regard to the earth's places in both figures, we shall obtain (with contrary signs) the values denoted by Z, Y, X.

Those who have examined the *Nautical Almanac* ephemeris of Halley's comet, and the sketch of its anticipated apparent path, will have perceived that an uncertainty in the epoch of perihelion, chiefly affects the declination of the comet, at and after its passing the ascending node. Having this in view, I was much perplexed by the notice (which appeared in the *Times*) of the first observation of its place by Dr. Hussey on the 23d of last month; for the declination there quoted being 23° 45′ 20″, the writer immediately gives the corresponding computed place in the *Nautical Almanac*, as 25° 21′·1, and adds, "A closer agreement could not have been hoped for." Now, the declination actually given for 23d August in the book, is 24° 45′ 3″; that quoted being, in reality, applicable to 27th August. But the difference between the two former numbers (very nearly a degree), appeared to me much too great to justify the writer's expression of satisfaction; and I consequently inferred a typographical error, and that the declination really observed was 24° 45′ 20″.

A determination of the comet's apparent place on the 1st of September, by Plana, and a rough one obtained at Lewes, on the night of the 17th inst., concur in removing the doubt which existed in my mind, as to the true place of the comet in its orbit. They show that the epoch of perihelion originally deduced by Pontécoulant, upon which the *Nautical Almanac* ephemeris is founded, viz., November 7th, ought to be postponed nearly (if not quite) ten days. The effect of this difference upon the future apparent path of the comet is very considerable; for, instead of passing below the seven stars of the Great Bear, it will actually go above, between them and the tail of Draco.

I ought to state, that M. de Pontécoulant, in a small tract issued some months since (and which is just published in English by Colonel Gold), states, that his re-calculation of the perturbations has induced him to postpone the perihelion to November 13th, and he gives an ephemeris and map founded on the elements so corrected. According to these, the comet ought to pass *through* the quadrilateral of the Great Bear. But that even these calculations are based upon too early an epoch, is evident from their giving for the 17th of this month, a place in the apparent path too forward by about 2½ days' motion.

Your correspondent, at p. 429, has, indeed, mentioned the 17th of November for the arrival of the comet at its perihelion; but I cannot help thinking, that, in this respect, he has somehow *blundered out the truth*; for the statement is quite inconsistent with the rest of his deductions, which all correspond to the epoch of the *Nautical Almanac*; viz., the 7th of November. As for the ephemeris which he professes to have taken, "with a few corrections," from the authority just mentioned, he really has contrived to mystify it in such a manner as to render it quite valueless.

I am, &c.
J. W. WOOLLGAR.

Lewes, Sept. 20th, 1835.

(*To be continued next week.*)

THE PATENT LAW AMENDMENT ACT.

The provisions of this Act (inserted in our last Number) may be considered under four heads.

I. The right which it confers on patentees of disclaiming or altering any thing which they may see amiss, either in the titles or in the specifications of their inventions. (Clause I.)

II. The right—opportunity at least—which it gives to every one to patent any thing he pleases, which does not happen to be in public and general use. (Clause II.)

III. The power given to the Privy Council to grant an extension of the usual term in Letters Patent (14 years) for any period not exceeding seven years. (Clause IV.)

IV. The alterations in the forms of process in actions for infringement. (Clauses III., V., and VI.)

1. The privilege of disclaiming and altering is thought well of by many—by some for whose opinions we entertain great respect; but for reasons which we have often stated, and need not here do more than generally refer to, (see Mechanics' Magazine, vol. xiv. pp. 26, 43, 271, 295, 317, 352,) we are persuaded that it will operate most mischievously for the public, and, in the long run, for inventors themselves. We do not dispute that there are at this present time many patents for most useful and profitable inventions, which, for want of a little patching, are in great danger; indeed, we know of several that are so, and dare-say the number might, on a rigid scrutiny, be wonderfully multiplied. Neither should we dissuade any one from making the best of the opportunity now afforded to him; on the contrary, we would advise every patentee who imagines he could be benefited by a little disclamation or alteration to lose no time; we wish to see the law now that it is law, and as long as it is law, followed out as speedily as possible, and to the greatest extent possible, that it may be seen how far our apprehensions of its evil tendency are well founded. If we are right in our anticipations, the result will be, that though some few meritorious inventions, of a past date, will be saved by this means to their authors, the majority of patentees will, from this time henceforth, designedly specify in so loose, careless, and mystifying a style, that the great object of granting such exclusive privileges—which is, that the public may obtain in return, full, clear, and explicit disclosures of the nature of the inventions patented—will be to a large extent wholly defeated. Liberty to disclaim and alter is substantially neither more nor less than a bounty on faulty specification. No one can expect to promote good and sound practice by an act of indemnity for botchers.

We are presuming, of course, that the privilege to disclaim and alter, as conferred by the Act, is one which may be readily and effectually exercised. The fact, however, is not so; for so clumsily has the Act been drawn up, that it is doubtful whether the privilege is really worth any thing. We happened to make the first application (in behalf of a client) that was made under the new law at the Attorney-General's-office, for a fiat to lodge a memorandum of alteration; and were informed, that the statute left the form of proceeding in so much doubt, and in any view so open to serious exceptions, that it could not be acted upon until a Case was laid before the law-officers of the Crown for their consideration and opinion; and that it was much doubted whether it could be acted upon at all. A Case, pointing out the technical difficulties in the way, has been accordingly prepared, and will be submitted to the learned gentlemen forthwith. We need not at present trouble our readers with a detail of these difficulties, but we shall, at some future time, lay both the Case and the Opinions upon it before them.

II. The second clause of the statute enacts, that though an invention for which Letters Patent have been granted, may have been previously invented and used by others—published even to all the world, though not, perhaps, used by all the world—yet on the Judicial Committee of the Privy Council "being *satisfied* that the patentee *believed himself* to be the first and original inventor;" and "that such invention, or part thereof, had not been publicly and generally used before the date of such Letters Patent," then new Letters Patent may be granted to him, which "shall be available in law and equity," to give to the patentee "the sole right of using, making, and vending such invention AS AGAINST ALL PERSONS WHATSOEVER, any law, usage,

or custom to the contrary notwithstanding"!!! We do not hesitate to designate this as one of the most monstrous provisions which ever disgraced the Statute Book. "Publicly and generally used!" What are we to understand by these words? Will the use of an invention by ten or twenty persons out of a hundred of a class to whom the invention is of advantage, or by two or three places out of a dozen where the manufacture to which it has reference is carried on, constitute such a *public* and *general* use of it as will save it to the public? Clearly not; far as the framers of the Act have (strange to say) omitted to alter the ratios of numbers, every *generality* must still, unfortunately as it happens, include a *majority*. The ten or twenty persons then who have previously known and used the invention—the two or three places out of the dozen where it has been in use—may see it all at once taken from them, by any one who can with a safe conscience, or with no conscience at all, aver that he never heard of it before! If, for example, an improvement in the woollen manufacture has been practised in Dorsetshire, but has not found its way into Wilts, Somersetshire, Gloucestershire, and all the Ridings of Yorkshire, that would unquestionably be a case of an invention, "not publicly *and generally* used." It would, therefore, be in the power of some cunning knave to take out a patent for it, which would be available to him and his assigns, "in law and equity," (God save the mark!) against not only all Wilts, all Gloucestershire, all Somersetshire, and all the Ridings in Yorkshire, but against all Dorsetshire to the bargain, though in that particular locality it may have been in use time out of mind, and regarded —justly regarded—by every one there as common property. The Judicial Committee are, however, to be "satisfied" that no knavery is practised; fully satisfied that the interloping patentee really "*believed himself* to be the first and only inventor." Wonderful security this! How are they to get at the *belief* of the party? How is it to be proved? Hitherto, belief has been regarded as a thing extremely easy of simulation, and incapable of verification; but behold a new court of inquisition erected, which is to be able to decide a question of belief as easily as a question of assault and battery! We doubt whether in the whole compass of English legislation there is any thing to match this. Even supposing it were possible to be "satisfied" beyond all possibility of doubt, that the patentee of an invention, previously but not "generally" known and used, was utterly ignorant of its prior existence—what are we to think of the policy of punishing all the rest of the community for this one's ignorance? Of the justice of depriving a number of persons of an invention which they have been long in the actual possession and enjoyment of, because some one of more wit than knowledge happens to be at the useless trouble of reinventing it for them? Of the wisdom of giving every ignorant man a right to appropriate to himself every thing of what he can safely say, "I never saw, or heard of it before?" Were such a rule as this to hold good, then, indeed, might we adopt with a little alteration the words of the poet, and say "since ignorance is bliss, 'twere folly to be wise." Great folly, indeed, for men of original and inventive minds to make themselves acquainted with what others have done before them — matchless folly ever to take a book of inventions into their hand, since the less they know of what has been previously accomplished, the more they would conscientiously be able to appropriate to themselves, that is, always supposing them to have some grains of conscience as well as "goupans" of genius. For, be it ever remembered, it is only the *public and general use* of an invention that is to prevent any man from appropriating it, whether in ignorance or in fraud, to himself. A full description of it may have appeared in print, in all the journals even of the kingdom; it may be a thing perfectly well known to every person of ordinary acquaintance with scientific literature; yet all this, notwithstanding, if it has not found its way into *general use*, and if a reinventor of it can only contrive to persuade the Judicial Committee of the Privy Council that he "believed" he was the first inventor of it; then, is it to become for fourteen years this person's exclusive property! Nay, so absolute is this supervening title, that it may actually have the effect of

robbing many an ingenious man *of his own*—of making a second inventor's right far better than that of the first. A person may have invented and communicated a most valuable discovery to a public journal—made a present of it, in fact, to the public, and with a view to the benefit of the public alone—but if the public should not happen to be sufficiently alive to its merits (a common enough case), should some time pass away without its being "publicly and generally" used, any other person is entitled under this new law of patents to step in, and lay proprietory hands on the gift, not only to the exclusion of him who made it, but of those for whose advantage it was intended! Surely, reformation never came in such a villanous flood as this before.

The principle on which the whole system of our patent laws has hitherto stood, has been to give protection only where there is priority of invention; and it is the only principle on which a good system can be built; for, as Dr. Johnson most shrewdly and justly observes—"A second inventor can only prove his pretensions to himself, nor can himself always distinguish invention with sufficient certainty from recollection." But this principle is completely broken down by this new system. Henceforth—as long at least as the Act under review continues unabrogated—the rule will be to give protection only to him who first catches the ear of the public.

We shall be told, perhaps, that the Act does not make it imperative either on the Judicial Committee of the Privy Council to recommend that new Letters Patent shall be granted, nor on the Sovereign to grant them; and that herein is a protection for all the evils we anticipate. The Act only says that the Committee "*may* report," and the King "*may* grant." This is quite true; but as the Act lays down, at the same time, most explicitly the principle on which the King and Council are to be guided in their decisions in this class of cases, and as the *Judicial* Committee can only act in a judicial not *legislative* capacity, we apprehend that in actual practice the *may* will be found to resolve itself into a very literal *must*. After a petitioner had shown that the invention for which he had obtained a patent was a useful one, and as far as evidence of belief can be given, that he "believed himself to be the first and original inventor" of it, and that, moreover, it was not at the date of his patent "publicly and generally used," we do not see how the Privy Council could reasonably resist the call that would be made on them to give him *the benefit of the Act*. Not one of all the reasons which we have given for considering it a most abominable Act, would be of any avail to them in the way of apology for not putting it in force. It is, and it will, of course, be their business to administer the law as they find it; the blame of giving them such a law to administer must belong to others.

III. The power which the Act gives to the Privy Council of extending the duration of patents for seven years, is the only part of it which we can contemplate with any degree of satisfaction. It is a good power so far as it goes; it does not certainly meet the full justice of the case, but it will, at least, prepare the way for it. Mechanical inventors will never, in our humble opinion, have full justice done to them, till they are placed on precisely the same footing as authors. Neither should it rest on the discretion of any tribunal whatever, to limit or extend their rights; they must have all that they are fairly entitled to, secured to them by all the sanctions which a permanent and unalterable law can afford.

IV. Of the alterations in the forms of process, in actions of infringement, we have left ourselves only room to say, generally, that they have terrorism for their basis, collusion for their choicest instrument, and the benefit of six-and-eightpenny legislators for their chief end. Did room permit, we could throw such a light on the private history of this Act, as would make more than two or three very busy bodies run for concealment to any hole or corner that offered—a foul chimney with a ragged and sooty innocent for companion—not excepted. But 'tis, perhaps, as well; the Act is its own best commentary; there wants no private history to convince every intelligent and reflecting mind that the persons who framed it (the real, not the ostensible framers we mean) could have neither at heart the good of inventors nor the good of the public.

CORROSION OF THE IRON SHACKLES AND BOLTS OF THE BUOYS IN KINGSTOWN HARBOUR.

(Extract from the Report of Professor Edmund Davy to the Irish Board of Works.)

"I beg leave to acquaint you, for the information of the Commissioners, that I commenced my experiments on one of the buoys at Kingstown Harbour on the 26th November, and continued them on another buoy on the 19th December, in company with the harbour-master, who kindly afforded me every facility in his power.

"The buoy on which I first operated (being the only one on shore) was unfavourably circumstanced for my experiments, because none of the lead had been removed from its lower surface, and the iron shackles and bolts attached to it were very much corroded. The principal corrosion, however, appeared to have taken place near the lead at the bottom of the buoy, or within a short distance of it. My first experiment was designed to ascertain whether a given weight of the corroded iron-work connected with the buoy would, when protected with a sufficient surface of zinc, undergo any farther corrosion, or lose any weight in sea-water. Accordingly the iron shackle, link, nut, and forelock, immediately close to the buoy, weighing together 57lbs., had attached to them four small ingots of zinc.

"On the 15th December, I examined this experiment, Owing to a strain on the iron shackle, one of the pieces of zinc had been forcibly removed; but the appearance of the iron in the vicinity of the other pieces of zinc was quite different from that of the unprotected iron, and much more free from corrosion than on the 26th November; the recent state of the experiment prevented me from trying if the iron-work had lost any weight.

"On the 19th December, my experiments were made under more favourable circumstances than before; the buoy on which I operated having had a portion of lead removed from its bottom, and the shackles and bolts being made clean. I have also made subsequent experiments with zinc, as a protector to iron in sea-water, and instituted comparative experiments in the harbour, to ascertain the rate of the corrosion of known weights of iron chain when unprotected, and the precise difference of effect when protected; also, whether bright surfaces of iron will oxidate or corrode when protected by zinc; but all these experiments have been too recently made to state the results.

"I beg leave to state that I have had repeated opportunities during the last week (in company with the harbour-master) of examining those buoys, which, agreeably to my suggestion in July last, had about three inches of lead removed from their bottoms, so as to break all connexion between the iron shackles and the lead and copper coating the buoys. Some of the buoys so treated have been down nearly six months, and I have no hesitation in saying, I consider the alteration a most beneficial one, and connected with the permanency of the iron-work. My opinion is founded on comparing these buoys with the buoys from which none of the lead has been removed. In the former, the corrosion of the iron-work seems to be very nearly arrested, and the shackles, &c. have become the abode of myriads of marine insects. In the latter, the iron-work is strongly corroded, and exhibits no vestige of animation on its surface.

"As the buoys at Kingstown Harbour are said to be of similar construction to those now in use at Portsmouth, and the latter, according to Mr. Loane, pilot-master, do not exhibit any such corrosion as the former, he has referred the cause of the corrosion 'to the stillness of the water at Kingstown Harbour, allowing the copper to act against the iron in a greater degree than it does at Portsmouth, owing to the greater run of tide there, which carries off the attractive influence, and it may be assisted by the lead being secured with metal nails.'

"I have had no opportunity of comparing the buoys at Portsmouth with those at Kingstown; but it appears to me that very slight differences in construction may occasion a material difference in the corrosion of the iron-work; and even admitting the exact similarity of construction of the buoys at both places, it is possible that a considerable degree of corrosion may take place in the iron-work of the buoys at Portsmouth, without being apparent to superficial observation, the loose oxide being carried off by the strength of the tide.

"The striking manner in which the corrosion of the iron shackles and bolts has been arrested, on the removal of part of the lead from the bottoms of the buoys in Kingstown Harbour, seems to show that the previous rapid corrosion was in consequence of the connexion of the iron with the lead and copper covering the surface of the buoys, and that the effect was at first justly referred by me to electricity or electrical action."

NOTES AND NOTICES.

Steam-Engines in New York.—The whole number of engines in operation is 86; aggregate amount of horse-power, 946.—*American Railroad Journal.*

There are in France 3,000 fire-engines served by 55,000 firemen, of whom 45 000 are armed and equipped. Upwards of 15 000 communes may receive succour in case of fire, in a very few hours. The sum provided by the communal budgets for the expenses of these establishments is 1 000,000 francs. In many places there is a great deficiency, which

is supplied by voluntary contributions. The expenses of keeping the engines in repair, and supplying the places of those which become worn out, are estimated at 30,000 francs annually. To the above engines, there must be added a great many more belonging to large manufactories and other establishments.—*Paris Advertiser.*

The Baltimore and Washington Railway is stated in the last American papers to be now opened for general traffic, the whole way to the foot of Capitol Hill.

Singular Steam-Boat Accident.—While a steam-boat on the Mississipi was running close to the shore on the 12th July, to avoid the current, a large cotton-tree suddenly fell across the boat with a tremendous crash, breaking through the boiler-deck to the lower, on which a dozen men were sleeping, all of whom had but time to leap out of danger before the huge trunk sunk deep into the deck, nearly severing one poor fellow in two, crushing the head of another, and slightly wounding one or two others. After the alarm caused by this occurrence had subsided, the tree was cut away, and the boat proceeded on her voyage. The tree was ninety feet long and four feet in diameter.—*American Railroad Journal.*

Explosion Unaccountable.—At Boston, on Saturday, the schooner Sarah, lying alongside Central Wharf, and loading for Hartford, suddenly blew up with an explosion that shook the surrounding buildings. Happily, no lives were lost. The vessel sank immediately. The extraordinary part of the affair is, that there was no gunpowder on board the vessel. The chief cargo was lime and saltpetre. We are at a loss to account for such an accident under these circumstances.—*Ibid.*

Arsenic.—This mineral, which in Cornwall was formerly thrown away as waste, now assumes an aspect of importance. Great quantities of it are collected from the flues of the burning-houses among the mines, where the tin is calcined previously to its being sold to the smelter. One manufactory for refining and making it merchantable has existed some years; another has recently started. Both are in full work, and now the crude article sells at the mines at between 1*l.* and 2*l.* per ton. It appears that the principal part of the refined article is shipped for France, but it is not generally known what is afterwards done with it, or in what branch of manufacture it is used. The refiners are vigilant in preventing any one who they think might be able to notice their mode of proceeding, from knowing what goes on within the walls of their establishments. From the great number of tin-mines, and consequently of burning-houses, in the western part of the county, it appears rather strange that the only refining factories are in Gwennappe, or that neighbourhood. Arsenic appears to be rising into importance, and a great quantity of it, in its crude state, as taken from the burning-houses, is carried openly by carts and waggons to the manufactories. The great danger to which the lives of human beings, as well as cattle, are exposed, by this mode of conveyance of the poisonous mineral, subjecting it to the influence of the winds and other accidental circumstances, renders it necessary that some regulation should exist to prevent its being conveyed in any other than *tight* carriages, with a *tight-fitted* cover. These precautions would not cost the manufacturer an addition of 6*d.* per ton, a consideration too trifling, it might have appeared, to render legislative enactments necessary, but regard for human life is sacrificed to a short-sighted view of pecuniary advantage.—*Mining Journal.*

Masses of Meteoric Iron in Mexico.—The mass of iron in the street of San Domingo, at Zacatecas, in Mexico, is 40 inches long, 23 inches broad, 13 inches thick, and its weight is estimated to be about 2,500lbs. The whole mass appears to be compact, but the surface presents several impressions of a globular form, varying in size, one of them being 7 inches in diameter, and 3 inches deep.—Another mass of iron stands in the north-west corner of the churchyard at Charcas, between Catorce and San Luis Potosi. Its height above ground is 32 inches. In appearance it closely resembles the mass at Zacatecas, and is exceedingly tough.—At Pablazon, a Hacienda to the westward of Catorce, is a third mass. Several small masses, some weighing 20lbs., have been found in the vicinity of the Rancho del Sitio, between Charcas and Pablazon, whence the mass at Charcas is said to have been brought.—*Trans. Geol. Soc.*

New Steam-Engine.—It is said the Rev. W. Morris, Minister of Dean-row Chapel, Wilmslow, in Cheshire, has invented a new steam-engine, the expense of erecting which will be less than a 10th part of the cost of a steam-engine of equal power; and the expense of working it will be less than 1,000th part of the expense of working a steam-engine of equal power.—*Times.*

Next week the Supplement to the present volume, containing title, table of contents, &c. and portrait of Charles Vignoles, Esq. C. E. Price 6*d.* Also, vol. xxiii. complete, in boards, price 9*s.* 6*d.*

We hope M. (Leeds) will think with us, that after the amends made in our present Number, the subject of his letter may be dropped.

Communications received from Mr. Beale—Mr. Dines—Dr. Pring—Tyro—A German—P. G. S.

LIST OF NEW PATENTS, GRANTED BETWEEN THE 22D OF AUGUST, AND 25TH OF SEPTEMBER, 1835.

James Fergusson Saunders, of Tenterden-street, Hanover-square, for improvements in clarifying raw cane and other vegetable and saccharine juices, and in bleaching such raw juices, being a communication from a foreigner residing abroad. September 1; six months to specify.

John Joseph Charles Sheridan, of Walworth, Surrey, chemist, for an improvement in the manufacture of soap. September 17; six months to specify.

William Mason, of Brecknock-terrace, Camden-town, engineer, for certain improvements on wheels, boxes, and axletrees of carriages, for carrying persons and goods on common roads and railways. September 24; six months to specify.

Joshua Procter Westhead, of Manchester, small-ware manufacturer, for certain improvements in the manufacture of small-wares, and an improved arrangement of machinery for covering or forming a case around any wire, cord, gut, thread, or other substance, so as to render the same suitable for various useful purposes. September 24; six months to specify.

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END OF VOL. XXIII.

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